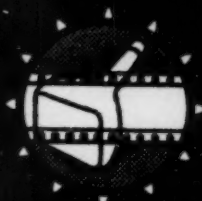


JOURNAL OF THE



SMPTE

- 569 **Internegative Symposium.** Preparation of 16mm Color Reversal Originals for 16mm Intermegative/Positive Release Printing • *R. A. Colburn* - 16mm Color Intermediate Negative/Positive Printing Procedures and Controls • *J. R. Stillings* - 16mm Intermegative and Color Positive Processing Controls • *William Hedden* - The Colormatic Printer • *Lloyd Thompson and K. B. Curtis* - Two 16mm Printers for the Intermegative and Color Positive Process • *Geo. W. Colburn*
- 581 Proposed Constitution Amendment
- 582 An Automatic Loop Printing System • *Mario Calzini*
- 585 A Versatile Multiple-Unit Re-recorder • *G. R. Crane and H. A. Manley*
- 589 A Low-Cost Transistorized Re-recording Mixer • *G. A. Brookes, G. W. Read and E. W. Templin*
- 594 Magnetic Dual-Dubbing Reproducer • *C. E. Hittle*
- 596 New, Compact Light Sources for High-Speed Photography • *W. R. Wilson*
- 599 A Flood Flashlamp for High-Speed Motion-Picture Photography • *W. C. Fink*
- 601 A Multi-PAR Lamp Luminaire for Light Projection • *F. E. Carlson*
- 605 New Horizons in Studio Production • *P. F. Wittlig*
- 609 A Mobile Videotape Recording System • *J. B. Hull and H. G. Hummel*
- 612 A Progress Report on Video-Tape Standardization • *A. H. Lind*
- 650 Video Tape Reports From Miami Beach Convention

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**SEPTEMBER
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A Symposium on 16mm Internegative/Positive Release Printing

ROBERT A. COLBURN, *Chairman*

This Symposium was first presented during the Chicago Section Regional Meeting held at Iowa State College, Ames, Iowa, November 8-9, 1957. At that time, the subject was comparatively new and many of the related problems still unsolved. The three competing 16mm laboratories in the Midwest then using the new medium welcomed the opportunity to get together and talk about their various problems and their methods of solving them. They were enthusiastic about the new products designed to meet a pressing need in the 16mm field. Since that time, much has been learned and several improvements have been made in the materials available and in the methods used.

It is still generally agreed that the finest quality 16mm release prints are obtained by printing directly from the 16mm originals on a color reversal print stock. But where a large number of release prints are required this method is a definite hazard to the original films, and is an expensive process.

For some years, especially since the introduction of Eastman Reversal Color Print Film, Type 5269, reasonably satisfactory release prints were obtainable through reversal color masters treated to reduce contrast. Although this method reduced the hazard to the original films and made the material

available for other uses, it did not materially reduce the cost of release prints. More important, the substantial degradation of color values made its use unsatisfactory where color brilliance was essential.

The new Eastman Color Internegative Film, Type 7270 made it possible to make release prints on Eastman Color Print stock with full color brilliance at a greatly reduced cost. It also made it economically practical for a laboratory to handle its own color processing with complete control from start to finish within the individual laboratory. Due to the characteristics of this new material, certain methods of more precise control had to be devised and new printing equipment designed and built in order to take full advantage of the capabilities of the new medium.

This Symposium deals first with problems encountered in the three major steps of print production — preparation of originals, printing procedures and controls, and processing procedures and controls — and then takes up equipment specially designed and built for 16mm internegative/positive use. The laboratories which participated in the Symposium were: Geo. W. Colburn Laboratory, Inc., Chicago; Lakeside Laboratory, Gary, Ind.; The Calvin Co., Kansas City, Mo.

Preparation of 16mm Color Reversal Originals for 16mm Internegative/Positive Release Printing

By ROBERT A. COLBURN

The Geo. W. Colburn Laboratory sets up originals in A & B rolls to incorporate fades, lap dissolves and invisible splices; timing is both for color balance and exposure balance; originals are cued for automatic printer operation; and originals are treated to minimize the formation of Newton's rings.

THE MAIN OBJECT in preparing an original 16mm film for color internegative/positive release printing is to introduce adequate color correction, exposure correction, and fade- and lap-dissolve effects directly in the internegative so that release prints can be made on a high-speed color positive printer using

a single uniform exposure and color filter pack throughout. Naturally, it is desirable to be able to do this on the first try, since remakes at this stage are costly to the laboratory.

The standard method of A & B roll setup as recommended by the Association of Cinema Laboratories can be followed by the client or by the laboratory editing department. This method has been reported in the *Journal* ("A report from the Association of Cinema Laboratories," pp. 383-386, July 1955). Several bulletins have been

issued by the Association on the subject. The Geo. W. Colburn Laboratory has prepared its own bulletin, combining and condensing information especially applicable to its operations.

When the A & B rolls are ready for timing, the utmost in care, experience and judgment is required to achieve the exact color compensating filter needed for each scene to keep a given sequence in color balance, and the exact exposure needed to keep each scene in density balance. These two operations are handled separately. The entire film is carefully examined over a light box with actual color compensating filters laid over adjoining scenes until a satisfactory balance is obtained. This operation can be done more rapidly

Presented on October 20, 1958, at the Society's Convention in Detroit by Robert A. Colburn, Geo. W. Colburn Laboratory, Inc., 164 North Wacker Dr., Chicago 6.
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Fig. 1. Timing card used by Geo. W. Colburn Laboratory.

and easily if an edited reversal color work print is projected prior to the selection of these filters. The filters required are then recorded on the timing card (Fig. 1). For example, at 10 ft a 0.05 Magenta, a 0.10 Magenta and a 0.10 Cyan correction is needed. At 15 ft, standard filtration is satisfactory. Again at 42 ft a 0.10 Yellow and a 0.10 Cyan correction is needed, and so on throughout the film.

Generally speaking, a 16mm color original filmed by a competent producer on one emulsion and one type of film stock will need very little, if any, color correction. Where film types are intermixed, such as Daylight Kodachrome, Type A Kodachrome and Commercial Kodachrome and even the new Ektachrome Commercial Film, Type 7255, filter corrections will rarely exceed a CC.10 from standard, except where gross errors are made in lighting or where special effects are desired. With Anscochrome, we have found that while filter corrections from CC.30 to CC.50 are sometimes needed compared to the Eastman products for printing on Eastman Reversal Color Print Film, Type 5269, relatively small compensation is needed for internegative use. However, we do not recommend the intermixing of color originals of different manufacture unless special tests are made prior to printing the internegative. It might be well to point out here the danger of intermixing color originals of different manufacture or where extreme errors exist in color balance. The reproducing characteristics may vary so widely that adequate color compensation cannot readily be accomplished except by setting up separate C & D rolls. This,



Fig. 2. Timing and cuing device for exposure correction.



Fig. 3. Final timing card.

of course, adds considerably to the cost of the internegative.

Time for Exposure Correction

When the color timing operation is complete, the film is timed in the usual manner for exposure correction, taking into account the density values of the color correction filters. This is done on a specially built timing and cuing device (Fig. 2). Both the A & B rolls are passed through at the same time over identical illumination so that balance from one scene to the next can be maintained, although the scenes alternate from one roll to the other. The final timing card is made (Fig. 3) showing the exact footage from the Start Printer Sync of each roll where each change in exposure or color filtration occurs, or where a fade-out or fade-in is required. By this time, the color filters have been

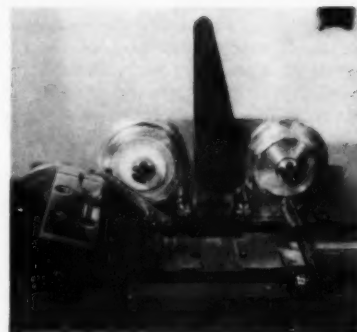


Fig. 4. Cuing device used to apply small patch of cuing tape.

translated into A, B, C and D and are recorded in red.

As each change is recorded, a special cuing device is used (Fig. 4) to apply a small patch of Permacel cuing tape. This is a new pressure-adhesive metallic material with tenacious sticking power through subsequent cleaning and printing operations. It has positive electrical conductivity, and yet is easily and completely removable if a change should be desired. The patch then passes through an electrical testing device which is identical to the split roller actuator on the printer. The patch is placed (Fig. 5) directly between the perforations at an interval of $32\frac{1}{2}$ frames ahead of the desired change.

After the timing cards have been completed, the original film undergoes a final cleaning while the charting operator (Fig. 6) perforates a strip of standard 35mm machine leader with a specially designed electromechanical punching device. The four buttons across the top are the four color filters, A, B, C and D. The seven buttons (partially covered by the operator's hands) control the proper neutral density filter combinations to effect eight different exposure values. The

Fig. 5. Patch is placed between perforations at an interval of $32\frac{1}{2}$ frames ahead of change.



Fig. 7. Completed chart. First row on the left actuates fade-out and fade-in mechanism. The next three give various combinations of neutral density filters. The last four give various combinations of color correction filters.



Fig. 6. Electromechanical punching device perforating a strip of standard 35mm machine leader.

single button in between operates the punch for the fade mechanism. To the left and right of the main exposure bank are buttons for advancing the chart to the next position.

Figure 7 shows a completed chart. The first row on the left indicates fade-out and fade-in, the next three indicate various combinations of 0.10 neutral density, 0.20 neutral density and 0.40 neutral density, giving eight exposure combinations. These neutral density filters allow for a range of $2\frac{1}{2}$ stops in increments of $\frac{1}{2}$ -stop or, in more technical language, approximately 0.10 log E units. The last four rows indicate color filters A, B, C and D. This combination of four color filters allows for as many as fifteen different color variations (within the limits of the filters used, of course) in printing an individual roll of film. These filters can be changed as desired for any special requirements of a particular original.

In the final cleaning of the original film, we have found it undesirable to use a cleaner containing an antistatic ingredient. Although it cannot be detected visually, its residue can affect the sensitivity of the raw stock and cause spotting. Great care must be used in removing all traces of grease pencil, tape marks and other foreign matter. One procedure is to use a swatch of white jersey acetate rayon soaked with a non-antistatic solvent of the trichloroethane type with adequate ventilation, so that it is completely evaporated before contact with the film roll.* Some originals may become excessively scratched due to prior use as a projection

* Since this paper was presented the Laboratory has obtained a new CF-2 Ultrasonic Film Cleaner manufactured by the Lipner-Smith Corp. This cleaning method has superseded the hand-cleaning method for all preprint materials, except for lacquered or magnetic-oxide striped originals.

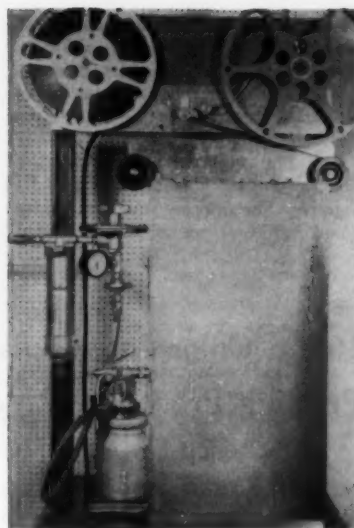


Fig. 8. Device for special spray treatment to prevent formation of Newton's rings.

original or an attempt to edit the originals directly without the use of a work print. These scenes require a special lacquering process before printing. In this case, subsequent cleaning must be done with Freon 113 solvent in order not to remove the lacquer.

Special Spray Treatment

Due to the slick emulsion characteristics of the internegative emulsion, it has been found necessary to use a special spray treatment to prevent the formation of Newton's rings. In this specially built device (Fig. 8), the original film is passed over an opening in the top of a Lucite box into which American Type Founders Non-Offset Mix #109 is sprayed under high pressure. Only the finest particles rise to the opening and form a coating, that is invisible to the naked eye, on the picture area of the film emulsion. There is some danger that if the spray gun is not adjusted properly, overly large particles may rise to the top and cause spotting. A special baffle has been introduced to prevent this.

In any case, if spotting should occur, the material can be effectively removed by a simple washing process. It has been reported that Eastman Kodak Co. is making some progress towards solution of the Newton's rings problem by the application of an over-coat on the negative emulsion; but for the present, spraying is required, particularly for the new Ektachrome Commercial and for Ansco Color, both having characteristically smooth emulsions after processing.

Edit. Note: Following the presentation of the paper, a color positive demonstra-

tion film was shown to illustrate the capabilities of the internegative printer designed and built by the Geo. W. Colburn Laboratory. A portion of the exposition accompanying the film is abstracted below:

The film was printed on Eastman Color print stock from a color internegative. The internegative was printed from various types of color reversal

original. It was noted that valuable edited originals were protected by using the internegative for long printing runs.

The internegative printer employs both color and neutral-density filters to make instantaneous scene-to-scene color and exposure changes to correct for deficiencies in the original.

Uncorrected and corrected comparison

scenes were shown to demonstrate the improvement possible when printing intercut original scenes with dissimilar emulsions, underexposure, and "old age" dye changes.

Other scenes were shown to demonstrate quick and normal length fade and dissolve effects, incorporated in the internegative by means of a variable shutter.

16mm Color Intermediate Negative-Positive Printing Procedures and Controls

By JOHN R. STILLINGS

Printing procedures and control techniques using an additive printer in the production of 16mm color positive prints from 16mm reversal color film are described. Matrix algebra is used in determining a basic exposure for each emulsion type and number used. These matrices can be used for initial printer calibration as well as for routine printer control.

P RINTING PROCEDURES and control techniques using an additive printer, parallel the procedures and techniques used in subtractive printing. The same precautions and safeguards are maintained, but with modifications due to the differences in equipment. Those differences as they affect the printing of Eastman Color Internegative Film, Type 7270 and Eastman Color Print Film, Type 7382 are discussed.

The printer can derive its information from two sources. One of these is a switching panel and the other is punched tape. The function of the switching panel is to provide a wide range of intensities of blue, green and red light. This allows the printer to be balanced to print Eastman Reversal Color Print Film, Type 5269; Eastman Color Internegative Film, Type 7270; Eastman Color Print Film, Type 7382; and black-and-white duplicate negative film. For each film type, there is an available range of 1.27 log exposure in each color, in 0.01 log exposure steps. The purpose of the punched tape input is to allow for scene-to-scene deviations from a standard printing level, in 0.02 log exposure steps. The switching panel is a control operation; the punched tape, a production printing operation.

Timing of original color film for printing is probably the most time-consuming and costly of all preparatory steps. It would be of economic importance to have one timing operation suffice for all subsequent printing steps. That is, it would be valuable to use one set of

punched tapes, representing one timing, to print Type 5269 Reversal Color Print Film, Type 7270 Internegative, or black-and-white duplicate negatives. The goal is, in the case of duplicate negatives, to have a fully corrected duplicate which will print to the print film at one light.

The first step in setting up such a printer is to establish the "standard characteristic curves" for each film type. These curves are the sensitometric plots of a print-through of a silver step wedge, which yield a good visual and densitometric match to the original wedge. In the case of reversal print film, this is a one-step operation, silver wedge to print film. In the case of internegative it is silver wedge to internegative to print film.

The standard characteristic curve for Type 5269 Print Film was prepared by printing a silver step wedge onto the film at various color balances and densities, using the switching panel inputs to the printer to adjust the exposures. The exposure that gave the best visual match to the original step wedge was chosen, and the densitometric plot was made. This is our standard curve for the Type 5269 Print Film. The exposure was designated the basic exposure for that type and emulsion number. Since the goal is to achieve one timing operation to cover all possible release printing routes, this graph is also the goal plot for the overall print-through of Type 7270 Internegative to Type 7382 Color Print Film.

In printing and processing Internegative Print Film, Type 7270, it is very difficult, if not impossible to evaluate the internegative visually. There

is no original negative with which to compare it, nor is there a simple negative to view. The general overall characteristic supplied by the masking dyes, as well as all the original colors which appear as their complementaries, limits the criteria for making an exact and accurate evaluation.

In order to fix one of the variables in a two-step process, first, our Type 7382 Color Print standard characteristic was defined and the Type 7270 standard characteristic then defined by means of this Type 7382 standard.

A silver step wedge was printed through to Type 7382 Color Print Film, using a piece of unexposed but processed Type 7270 as a filter. The exposure was adjusted by means of the switching panel until a good neutral print was made. This then established the Type 7382 Color Print Film standard characteristic curve. The exposure was called basic exposure for that Type 7382 emulsion.

A similar procedure was followed in the case of the Type 7270 Internegative, but without the cleared negative filter, until a negative was produced which when printed at the basic exposure on Type 7382 Print Film, yielded a print-through characteristic which matched the Type 5269 Reversal Print Film standard characteristic. The exposure given to the negative was then defined as the basic exposure for that emulsion number of film and the plot was defined as the standard characteristic curve for Type 7270 Internegative.

For routine day-to-day control procedures, Type 7270 Internegative is printed at the basic exposure for that particular emulsion and a densitometric plot is compared with the standard characteristic curve for Type 7270. In the case of the Type 7382 Print Film we have dispensed with the negative filter and merely print at the basic exposure for that emulsion and compare its plot with a graph of the original basic exposure, which was also printed without a filter. We do not get a neutral

Presented on October 20, 1958, at the Society's Convention in Detroit by John R. Stillings, Lakeside Laboratory, Box 2408, Miller Station, Gary, Ind.
(This paper was received on April 1, 1959.)

image, but since all the control procedures are densitometric, this does not matter, as long as the curves match.

Each new emulsion, and for that matter, each roll number within a given emulsion number is tested and a print is made which will match the standard characteristic for that emulsion type. This print characteristic is checked on each emulsion before production begins and is checked periodically throughout the supply of that film.

Using a test emulsion that is stored under controlled conditions, we also check out the printer each day to insure the reproducibility of the printer. This emulsion is also used for any testing of printer functions or to check the printer after any repairs or changes.

Control Program

The control program as outlined, necessarily consists of a large number of densitometric plots and takes considerable time in the evaluation.

With ideal film and with ideal densitometry, one would, when trying to make one set of curves match another, merely place one set of curves over the other and shift each curve for each color until it matches the desired characteristic. The displacement of the curves along the log exposure axis would be the required log exposure change to make in the printer setup. In actual practice, this results in a series of successive approximations. When the green exposure is changed by a large amount it also changes the blue and red curves by a smaller amount. When the desired change is small, the displacement of the other two curves is slight and can be estimated directly. When

the desired change is large or consists of more than one correction at a time, the effect on the other curves is sometimes difficult to evaluate.

These secondary effects were measured by printing each film type in the following manner:

- (1) basic exposure,
- (2) basic exposure plus a blue increase,
- (3) basic exposure plus a green increase,
- (4) basic exposure plus a red increase.

All four tests were then processed, read and plotted. Taking the basic exposure graph as a base, the shifts of the other curves in the accompanying tests were tabulated.

Log E change from basic exposure	Densitometric curve shift
delta Blue	$Y_b \quad M_b \quad C_b$
delta Green	$Y_g \quad M_g \quad C_g$
delta Red	$Y_r \quad M_r \quad C_r$

Where Y_b is the shift of the yellow dye layer due to the change in blue exposure, M_b is the shift of the magenta layer due to the blue exposure, C_b is the shift of the cyan layer due to the blue exposure, and so on.

If each of these changes is divided by the log exposure change, the resulting matrix describes the amount of curve shift for each color for a given exposure.

$$\begin{array}{ccc} Y_b & M_b & C_b \\ \frac{Y_b}{\Delta B} & \frac{M_b}{\Delta B} & \frac{C_b}{\Delta B} \\ \frac{Y_g}{\Delta G} & \frac{M_g}{\Delta G} & \frac{C_g}{\Delta G} \\ \frac{Y_r}{\Delta R} & \frac{M_r}{\Delta R} & \frac{C_r}{\Delta R} \end{array} = \begin{array}{ccc} Y_g & M_g & C_g \\ Y_r & M_r & C_r \end{array} = M$$

Curve shift	Inverse matrix	Log exposure change
B'	$yB \quad mB \quad cB$	$B'yB + B'mB + B'cB = \text{Blue}$
G'	$yG \quad mG \quad cG$	$G'yG + G'mG + G'cG = \text{Green}$
R'	$yR \quad mR \quad cR$	$R'yR + R'mR + R'cR = \text{Red}$

The actual information desired is not the amount of curve shift for a given exposure change, but the amount of exposure change necessary to give a known curve shift, that is, the inverse matrix. This can be found by classical matrix manipulations.

$$\begin{array}{ccc} yB & mB & cB \\ yG & mG & cG \\ yR & mR & cR \end{array} = M^{-1}$$

After a test has been run and plotted, it is compared with the desired curve. The curve shifts parallel to the log exposure axis are noted. Each of these desired curve shifts is multiplied by all the terms in the corresponding row of the matrix. The algebraic sum of all the product terms in a row is the change in exposure necessary for that color (see formula below).

Conclusion

The author has not attempted to describe many of the specifics of printing operations, but has chosen to emphasize some of the methods in use that are different from conventional techniques. Some of the reasons for such changes are due to the differences in film types and certain problems associated with these films. These methods were developed to help meet the goals set for the Lakeside Laboratory's 16mm program.

16mm Internegative and Color Positive Processing Controls

Processing control of 16mm color internegative and color positive is necessary to produce a high-quality product. This paper deals with methods of photographic and chemical processing production controls and their coordination with motion-picture printing controls.

WHEN EASTMAN Color Positive and Color Internegative films were introduced several years ago, the Calvin Company had had previous processing experience with color film. Eastman Kodachrome duplicating film had been processed in our laboratory since 1950. The experience in processing controls

gained through the developing of Kodachrome has been applied to the internegative and color positive films. In some cases, it has been found that these two films do not require as extensive or as complicated control as does Kodachrome in its duplicate processing. In other instances, previous experience proved inadequate, and new control methods and procedures were required. This paper is intended as a report on the application of generally accepted methods of processing control and procedures found useful in our produc-

tion for developing the internegative and color positive films.

Processing controls generally are classified into chemical, photographic, and mechanical applications. Mechanical and photographic control methods have been known and used for several decades; however, the method of chemical control through analytical procedures has been extensively utilized only within the last few years. We learned that the internegative/positive system does not require as many or as involved chemical controls as Kodachrome duplicate processing; also, we learned that by placing first emphasis on a highly accurate chemical control system, the photographic and mechanical control phases are simplified. Process variations seem

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Fig. 1. Use of chemical controls simplifies photographic and mechanical control phases.

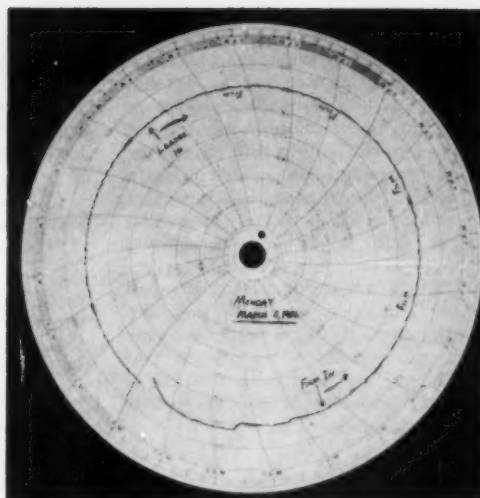


Fig. 2. Chart of temperature variations.

to be most frequently caused by chemical changes. By controlling the process chemically, the photographic and mechanical controls serve mainly as checks on the accuracy of the chemical control and physical operation of the developing equipment (Fig. 1).

Processing machine tanks are analyzed chemically at least once during each shift. Analysis is made immediately before any internegatives are processed; and, if necessary, machine additions are made and tanks are reanalyzed to provide the most complete approach to chemical standards possible before internegatives are processed.

This high degree of chemical control has been reflected in a similarly high degree of negative photographic uniformity. In the printing operation it is important that a negative, printed and processed today, produce an identical print under the same positive printing conditions as similar negatives printed and processed in the past or in the future. Extremely close chemical control is essential if this goal is to be reached.

Replenishing solutions are mixed by on-center mixers and stored in tanks with floating covers to reduce oxidation. These solutions are, of course, analyzed before being accepted for production use. Again, critical chemical control of replenishers is reflected in low chemical variability in tank solutions. Long-range statistical controls also are used both for machine tank and replenisher systems.

Mechanical control of the processing machine and its allied equipment is necessary if the conditions for a standard process are desired. Traditionally, time, temperature and agitation are controlled mechanical conditions, but the mechanical feature of replenishment additions is of equal importance. Processing

time is easily checked with a stop watch, and very little time variation is noticed on our rigid-rack constant-speed machines. Temperature control within $\frac{1}{2}$ F is not a great problem with the commercial equipment that is available today. The recording temperature control equipment is important to show temperature variations or malfunctions of the equipment (Fig. 2). Checking the calibration of the automatic temperature control equipment with a mercury thermometer frequently placed in the machine tank is a long-range method of temperature control that cannot be neglected.

Recirculation of the developing solution with adequate filtering is undertaken to provide uniform agitation of film in the machine tank. The degree of recirculation is measured on a flow meter. Replenishing solutions to all tanks, including washes, are regulated by flow meters. A periodic calibration check on replenishment flow meters is desirable. If this calibration check is omitted, a dirty flow meter may be identified by long-range chemical control methods indicating abnormal machine chemical additions. Frequent flow-meter calibration checks, therefore, will lead to more consistent chemical control (Figs. 3 and 4).

Chemical and mechanical controls establish definite processing conditions. Photographic control is necessary to enable the technician to evaluate these process conditions and to provide a means of measuring variability. Sensitometric strips exposed on a special densitometer are processed along with film at definite intervals. Our laboratory uses an Eastman Model 31A electronic densitometer to measure these processed strips (Fig. 5). Definite photographic standards of good print quality having

been established, these processed sensitometric strips indicate how well the process conforms at that time to a fixed standard. Readings from strips at time intervals are plotted consecutively to indicate a running process control. Processing trends can be determined by such a chart, and the laboratory can in relation to good quality set limits which should not be exceeded (Figs. 6-8).

A photographic picture strip con-

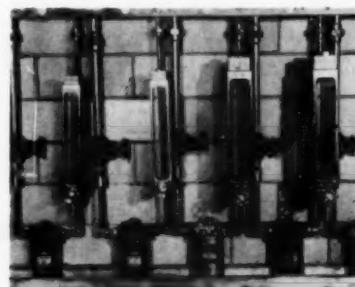


Fig. 3. Flowmeters.

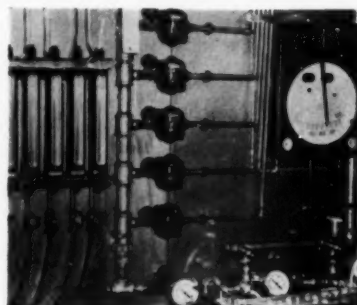


Fig. 4. Flowmeter calibration checks are made frequently for more consistent chemical control.



Fig. 5. Eastman Model 31A electronic densitometer used to measure processed strips.

taining a soundtrack is also processed along with each sensitometric strip. This picture strip is exposed on a production printer and provides a quick double check on sensitometric strips.

If both the sensitometric strip and the picture strip show a trend away from standard, the results have considerably more significance than when a single strip varies independently. This method of checking is often quite valuable in detecting processing variations. Picture control strips are also useful in observing the mechanical action of sound applying equipment.

While all methods of processing control are valuable and necessary, the importance of the interpretation of the

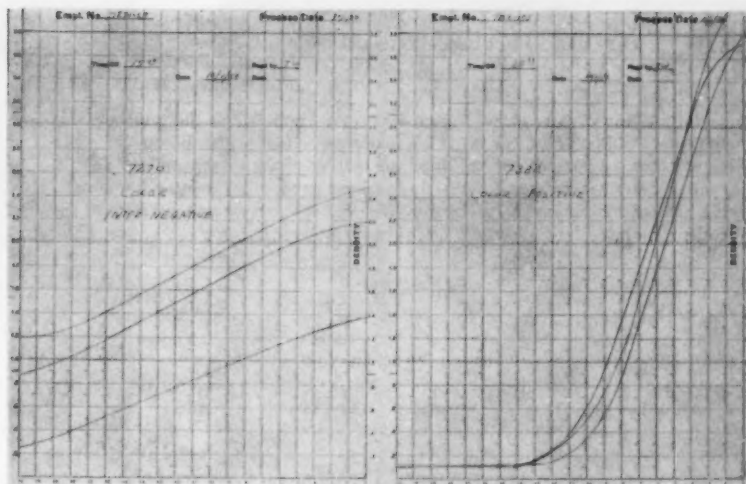


Fig. 6. Plots of internegative and color positive sensitometric strips.

data thus obtained must not be overlooked. We have found that processing control personnel must make a quite general, unbiased examination of all data received to maintain a consistent process. The chemist, the equipment maintenance technician, and the photographic control technician must work as a team with an open and inquisitive mind for the proper evaluation of control data.

All operations of printing and processing controls are closely interconnected, so for good print quality and

uniformity, the actual inspection of finished prints must be regarded as one phase of processing control equally as important as earlier phases.

It is the print that is delivered to the customer, so careful inspection of the finished print is necessary as a final point of processing control. It has been found that during the print inspection the observation of printing and processing conditions or changes is helpful in the evaluation of uniform operating conditions of both processing and printing controls.

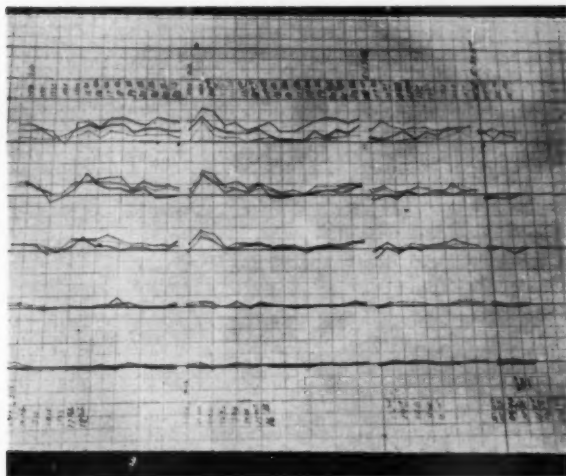


Fig. 7. Processing color control chart.



Fig. 8. Coordinating photographic and sensitometric control.

The Colormatic Printer

By LLOYD THOMPSON
and KENNETH B. CURTIS

The making of 16mm color prints from color original reversal by the internegative system is more difficult and exacting than making reversal prints. Black-and-white equipment must be extensively modified, or new color equipment must be built. This paper describes in detail a new high-speed production printer for making positive prints from the internegative, and outlines problems involved in its design and construction.

WHEN 16MM INTERNEGATIVE became available, many people thought it would be much simpler to process and handle compared with the reversal color duplicating or Kodachrome duplicating process. It was also assumed that it would be possible to convert black-and-white processing machines, printers, etc., in order to handle the color material. While some of these assumptions are, in a way, true, many of them simply have not worked out. For instance, in our laboratory where we run both the Kodachrome and negative/positive color processes, at the present stage of the art it is much easier to get consistent results from Kodachrome than it is from the internegative system.

It is also true that printing and processing equipment can be revamped on occasion so that it can be used to print and process color. However, in our case, most of the printing and processing equipment was already in use and there was little advantage in converting equipment. It was preferable to build new. At the present time we are making color internegatives on a step printer which was, and is, used for making black-and-white duplicate negatives and Kodachrome prints. By some conversion in order to get more light it is possible to make color internegatives using this machine.

Continuous release printers for printing internegatives to color positive and processing machines to handle the material have been built especially for the purpose. We have under construction a new step printer for making the internegatives which may give better results than those obtained from the present negative printer. Thus, while it may be possible to convert existing equipment for the color negative/positive process, if the best and most economical results are to be had it is highly desirable to use equipment which has been designed and built specifically for the purpose.

It is not possible here to discuss step printers, release printers and processing machines, so discussion is limited to the continuous printer for making release positives from color negatives and sound-

tracks. The printer which we have designed and built is known as the Colormatic Printer (Fig. 1).

In building such a printer we had these objectives in mind:

1. *Speed.* The initial objective was a printer that would run as fast as possible. This objective was soon modified to "as fast as practical." We found that we had enough light to print up to 1000 ft/min and the results were the same as if the printer had been run at a lower speed. It was not practical to run at the highest possible speed because the take-ups presented a serious problem and, more than that, the operator was not able to keep up with the machine. We therefore settled on a speed of 250 ft/min which seems practical.

We attempt to make all internegatives contain the light changes, optical effects

and color changes, so that we end up with a one-light negative for release printing. It seems much more economical to do it this way and occasionally make over a negative which is not correct rather than to try to operate light or color changes while printing from the negative. To put such changes in a release printer would mean running it at a much lower speed with resultant complications. In order to get the maximum amount of work consistent with the least wear on the negatives, the printer runs in both directions.

The printer has four raw-stock magazines so while a print is being made in one direction the operator can unload the print which has just been made and reload the raw stock into another of the magazines to print in the reversed direction. With these considerations, a speed of 250 ft/min is apparently the most practical.

2. *Production of prints as nearly perfect as possible.* In order to get a good print, it is, of course, necessary to have good contact and the smaller the area which must be brought into contact when two films are placed together the better the contact.

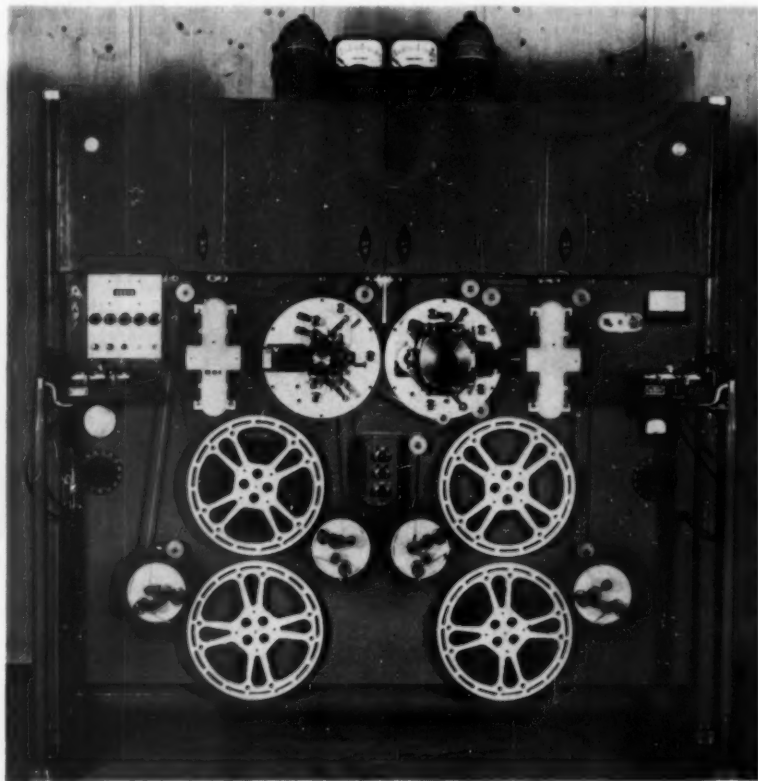


Fig. 1. The Colormatic Production Release Printer.

Presented on October 20, 1958, at the Society's Convention in Detroit by Lloyd Thompson (who read the paper) and Kenneth B. Curtis, The Calvin Co., 1105 Truman Rd., Kansas City 6, Mo.
(This paper was received on October 17, 1958.)

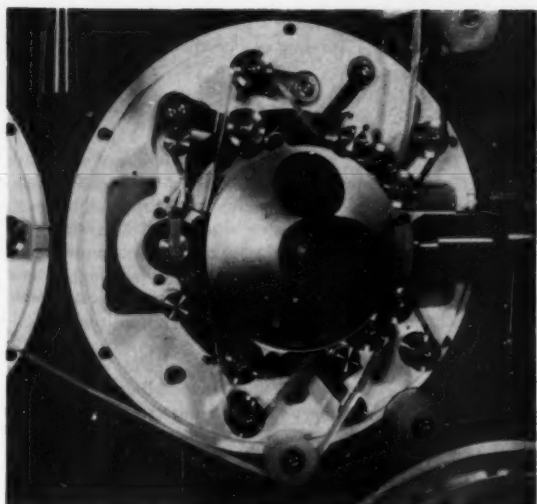


Fig. 2. Printing head. A 60-tooth printing sprocket is used to provide space for large filters.

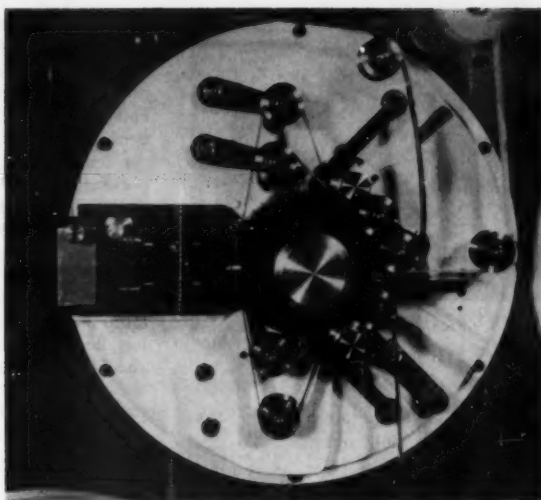


Fig. 3. Soundtrack printing head.

While designing this particular printer we built one printer with excessive contact. As a result, we were troubled considerably with Newton's rings so the design was changed. The new design seems to give good contact without too much trouble with Newton's rings, providing the negatives have been sprayed. This type of printer is very steady. In a printer of this type, the necessary filters present a problem.

In order to print at the required speed, it is necessary to have a concentrated light source, and when this is provided the filters must be placed at some point in the system where the minimum amount of heat is transferred to the filters. This location is in the printing head. To provide space for larger filters, a 60-tooth printing sprocket is used (Fig. 2). Placing the filters at this point eliminates the curl problem of the filters, but the concentrated light going through the filter begins to change the characteristics of the filters after about two days' use. Eastman Kodak Co. recently introduced acetate filters which could be used for this purpose, and these are entirely satisfactory and much less expensive than the regular gelatine filters. In order to guard against any color change we put in a new set of filters each day. The choice of optics provides a uniform light system. The timing belt drive and the 60-tooth sprocket make uniform printing conditions.

Another head is used for printing the sound and in this case we have gone to something which is unorthodox, and which would not have worked a few years ago (Fig. 3). We know because we tried it. When we first began printing sound in the 1930's from 16mm originals, we had a printer which used a negative on the outside of the sprocket rather than on the inside. This means that the

raw stock was on the inside and the negative was on the outside. At that time the sprocket was inadequate and because of the shrinking characteristics of 16mm materials the printer was not consistent in its results. A suggestion made by Eastman Kodak Co. on an experimental printer, which John R. Capstaff built, led to the type of printing now used. Both a picture and a sound head using this principle were built. It did not work out for the picture, but has been entirely satisfactory for the soundtrack printing. We have had such a system in operation for almost two years. According to measurements on the soundtrack printed on this printer, contact and movement-wise, it seems to be entirely satisfactory. Movement is very good, which makes for good reproduction of the negative track and the contact seems to be very good. Densities of a release print made from a specific negative have a much wider range of usable densities on this printer than on other optical or contact printers which we have in use.

We have designed and cut our own sprockets for this machine. The picture head has a 60-tooth sprocket and a free-wheeling companion rail which equals the base diameter of the sprocket (Fig. 4), both of which are balanced. The purpose of this companion rail is to carry the unperforated side of the film in parallel to the sprocket while leaving an open path between them for the printing light. Since single-perforated films receive a one-sided pull a jittering effect may be noticed, especially if only one or two narrow teeth are engaging the film and the films are being dragged between pressure gate rails. This effect is relieved when there is a greater engagement of full-width sprocket teeth, shaped to conform with the film movement, and all rails contacting the films are free-moving.

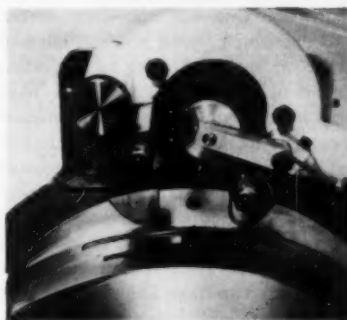


Fig. 4. Printing sprocket, traveling rail and pressure roller.

When both the sprocket and the free-wheeling rail shafts are mounted on pre-loaded ball bearings for positive non-defective alignment, the stability is improved. Since the aperture is large and actually a ghost image of one located elsewhere there is no streaking caused from dirt. There is no stroboscopic or ladder effect caused by the narrow aperture and the use of alternating light current and very little friction. Consequently, there is little wear — insuring long life to that part of the machine.

3. *Maintenance of a consistently high standard.* A release printer running at a high speed must be able to repeat accurately and consistently. In order to maintain a high standard, the best components obtainable have been used. Unfortunately, it is not possible to use a synchronous motor drive because of the necessity for controlled acceleration which, in connection with an automatic starting feature, repeats the determined rate of acceleration each time the printer is started. The motor maintains a uniform and accurate speed. Equally as



Fig. 5. Vacuum cleaners for cleaning negative before and after printing.

important as acceleration is the machine's deceleration and stop. To omit any means of control for its stopping would cause the printer to become unthreaded, and the reels thus freed would spin wildly. It was found that the only installation necessary was a good, reliable, electro-magnetic power brake in connection with the main-drive system plus one simple, little, no-drift, solenoid brake on each reel drive for use when threading the printer. Snubbers have been installed only for absorbing minute shocks in acceleration and deceleration.

Only the most reasonable safeguards have been incorporated in the take-up system, using partial compensation to correct for the excessive pull of empty raw-stock cores at the start and ending of a show. A two-stage adjustable voltage supply is available for those drives which serve alternately as take-up and supply according to the direction of the run. These motions are never electrically reversed. Reel and core shafts are a direct extension of the motor shafts with no mechanical reduction.

A footage counter with an automatic shut-off mechanism also has been built into the printer. This means that the printer can be set up to print to any given length and automatically stopped

at the same point each time in the leader section. Once set, the operation is automatic in both directions. It relieves the operator of the necessity of catching the end of the run and also saves footage because printing is not extended beyond the length needed. This feature is important in a high-speed printer. This device is made useful for printing sections by merely setting it for the desired length. It automatically shuts off when it reaches a predetermined point.

Expanded scale meters are used on the lamp current. In addition, a Densichron has been installed on the machine to check both the amount and the color of the light. Light sources are checked periodically in this manner. The Color-matic operates entirely on alternating current which seems to result in better regulation.

4. *Maximum number of prints with minimum wear.* Color internegatives are expensive and difficult to make so that once a negative which gives good prints has been made it is desirable to make as many prints from this one negative as possible. All possible measures are taken to protect the negative. Except in actually printing the picture, picture area does not come in contact with anything other than raw film, either on emulsion or base side of the film. Vacuum cleaners have been installed to clean the negative both before and after printing (Fig. 5).

The cleaning is done before the film goes on the take-up reel so as to prevent dirt and foreign matter from being rolled up in the negative and sticking to it. Rewinding negatives seems to wear them out almost as fast as printing so the printer has been built to run in both directions to assure a minimum of wear and to save rewinding and threading time.

Threading film in and around the two printing gates and onto the machine is a most exacting and tiring task at best. It aids production as well as preserves the negatives against wear caused by unnecessary handling and rewinding if this

operation is performed only once, at the beginning of a given run of prints.

5. *Long, hard service with few repairs to the machine.* A production printer should require little attention. Down time is extremely costly because not only are the printer and its operator idle but so, all down the line, are other facilities such as processing, inspection and shipping. For that reason, component items are all of top quality. Parts which might cause trouble from rust and corrosion are made of stainless steel or some other non-corrosive metal.

Such parts as bearings for the printing sprocket or other bearings were made extremely heavy and oversized, and as accurate as possible. The aim was to build a printer which when once adjusted would run for weeks or even months at a time without maintenance, other than cleaning and checking.

6. *Easy to operate.* We wanted a printer that would be easy to operate. Experience and statistics prove that people work more efficiently and become less tired under quiet, comfortable conditions. We therefore made an attempt to build a machine that would operate quietly and, in this, we feel, we have succeeded fairly well because it is much more nearly silent than many of our slower running printers. We operate the printers in individual rooms and these rooms are sound-conditioned as well as air-conditioned and humidity controlled. Attempts have been made to place the equipment where it is most convenient for the operator to use; and whenever there are indications that changes will make operation less tiring, then such changes will be made.

It is, of course, impossible to anticipate the future or do too much advance designing, so it will be interesting to see what changes have been made in such equipment in twenty-five years from now. All we can say with certainty is: we know it will be different.

Two 16mm Printers for the Internegative and Color Positive Process

By GEO. W. COLBURN

The internegative printer is a contact step printer for daylight operation. A mechanical dissolve shutter operates at two speeds. Light changes are accomplished by the use of glass neutral-density filters. Color filters are introduced automatically to make color-balance changes in individual scenes. The color positive printer operates at 300 ft/min and handles both color internegative and negative sound rolls in one pass.

THE INTRODUCTION of 16mm color internegative and color print films made new demands on existing printing equipment. Modifications were necessary because these new film stocks require much more light than is needed for black-and-white release positive emulsions or color reversal print stocks.

A printer setup, for instance, to properly expose Eastman Reversal Color Print Film, Type 5269, would require 100 times the light to effectively expose internegative stock. To expose through the internegative stock to color print stock requires 50 times the light required for the 5269 setup.

The following procedures would obviously increase the illumination: (a) remove neutral-density filters from pack; (b) install a more efficient lamp; (c) run the printer at a slower speed; and (d) increase size of the exposing slit. However, in the case of (a) it would be necessary to remove approximately 1.70 N.D. with perhaps only 0.40 N.D. available to remove. The (b) procedure would require designing and attaching a new optical system and lamphouse. For (c), a printer running 100 ft/min would have to be slowed to 1 or 2 ft/min. In (d), increasing the printing slit would gain in exposure but impair definition.

It was decided that the solution to the problem was to design two new printers each with a specific job to do. A step printer was the choice for making the internegative because the perforation of the internegative stock is the short pitch (0.2993 in.) which is the same as that of Kodachrome Commercial and the new Ektachrome from which it is to be printed. This method would assure maximum definition and steadiness in the negative. Also fades, dissolves, scene-to-scene color and light changes could be incorporated, making possible one-light printing to the positive. A continuous printer for handling the color internegative and soundtrack negative could be designed to run at very high speed where light changes are not in-

involved. Having the two negatives in splice-free condition is a real advantage in high-speed printing. It simplifies the cleaning problem as well.

Color Internegative Step Printer

This contact step printer (Fig. 1, left) is operated in ordinary room light (except, of course, for loading the magazine). Adequate light to print the extremely slow internegative stock at 30 frames/sec is provided by a 300-w T-type projection lamp burning at 90 v with diffuser and projector condensers.

The film transport system includes individual feed and holdback sprockets for each film in the enclosed housing (Fig. 2). The cam and square shuttle working in a square provide an accurate intermittent movement with room to spare for a 180° shutter opening. Two pins, one full-fitting vertically only, enter the perforations in a straight-in-

and-up motion with a pull straight out after a slight hesitation at the top of the stroke. The original film and the internegative stock have individual pairs of edge-guides to control weave and compensate for slight differences in width. Contact is assured by a light pressure in the center of the frame by a pillow-shaped fiber pad (Fig. 2). This has been replaced by a small ball-bearing roller to eliminate occasional scratches on the film base.

The light is modulated by three neutral-density glass filters (0.10, 0.20, 0.40) which give eight light steps, sufficient for normally exposed professional Ektachrome original. These filters slide up and down by action of small solenoids and return springs (Fig. 2). Four additional slides contain color filters for introducing individual-scene color correction. A standard filter arrangement may be used or a special gelatin inserted for extreme color balancing.

A conducting cue patch on the original advances a 35mm punched program strip. Fingers adjusted to microswitches (Fig. 3) drop into the punched holes and energize the selected solenoids which pull the filters up into the light beam and hold them until the next change is

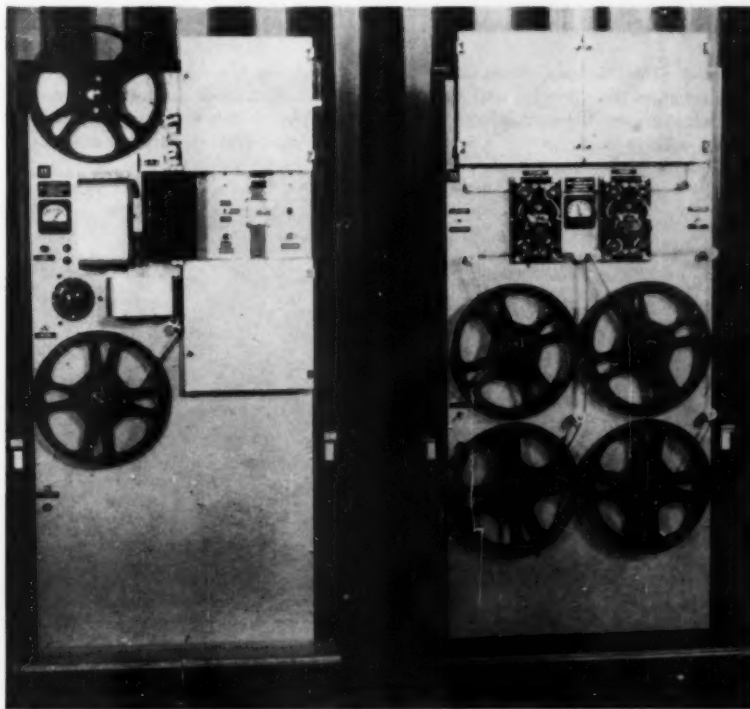


Fig. 1. Internegative printer (left); color positive printer (right).

Presented on October 20, 1958, at the Society's Convention in Detroit by Geo. W. Colburn, Geo. W. Colburn Laboratory, Inc., 164 N. Wacker Dr., Chicago 6.

(This paper was first received on February 13, 1959, and in final form on August 18, 1959.)

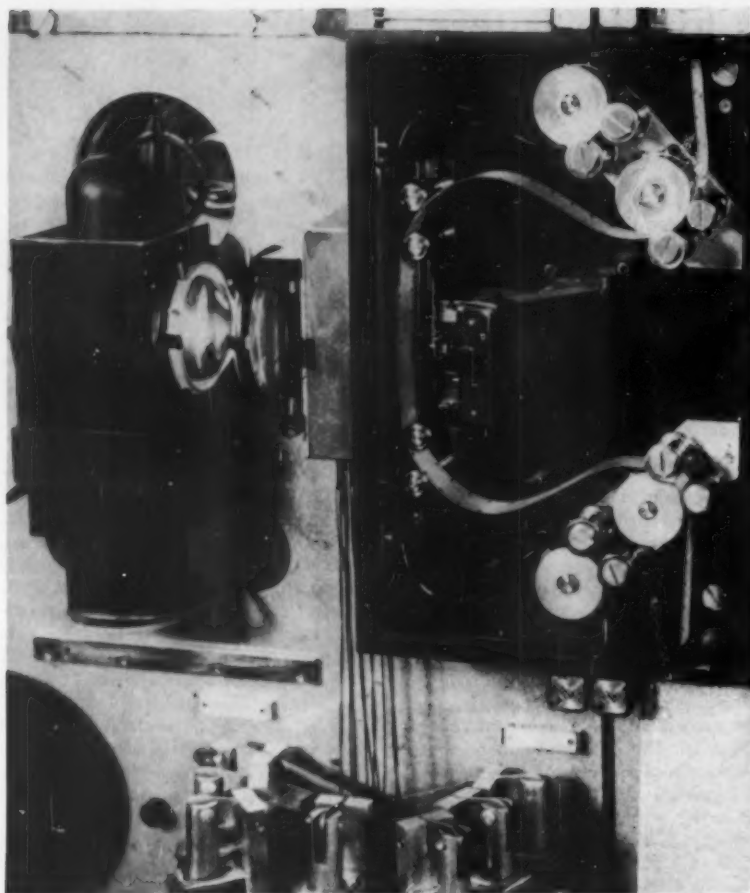


Fig. 2. Close-up of internegative printer with covers removed, showing arrangement of solenoids controlling filter slides.

required. The Number One series of holes operates the solenoids which allow a clutch to engage the mechanism operating the dissolve shutter.

There are two ratchet drivers (Fig. 3) geared at 20-to-1 and 40-to-1 speeds, respectively. When engaged with their individual cams, the drivers advance or

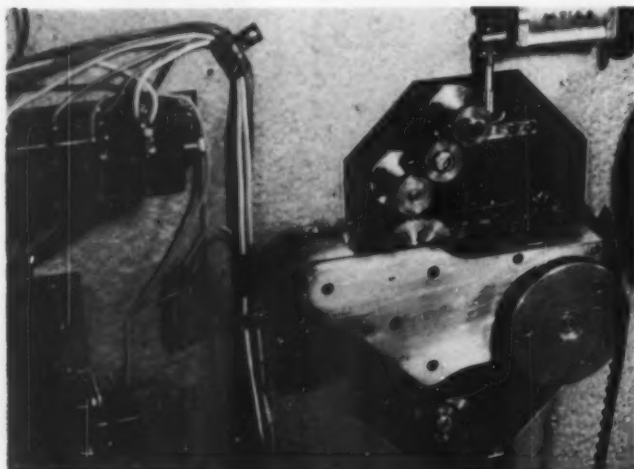


Fig. 3. Back view of internegative printer showing bank of micro-switches controlling filter slides and automatic shutter mechanism.

retard the adjustable shutter blade. The selection of the fade speed can be manually set according to a predetermined footage number while the machine is running. This is required only to intermix the two fade lengths.

Since most originals are set up in A&B rolls with the raw stock passing through the printer twice, a rewind motor is provided. The raw stock may by-pass the printer mechanism and be rewound in the printer magazines.

Color Positive Continuous Printer

The continuous contact printer (Fig. 1, right) is a double-head machine to handle picture internegative and sound-track negative simultaneously. This machine is designed to operate at 300 ft/min with a minimum of strain on the film and perforations. The two heads are driven by a single motor using a silent chain drive (Fig. 4) connecting the printing-sprocket shafts.

The printing-sprocket shafts are hollow so that the lamphousings may be mounted on the rear side of the machine panel. The light (Fig. 5) is brought through condensers and a front-surface mirror to the film. Relatively small projection lamps (only 300-w) are used at 90 v to maintain long life. The filament plane is focused and adjusted to fill the printing slit. Three heat-absorbing filters are mounted in the condenser tube (Fig. 6) between two plano convex lenses. The tube is well cooled from the lamphouse. Air, forced gently between the lens tube and the inside wall of the hollow shaft, escapes through openings in the printing drum, eliminating heating of the sprocket shaft. Room temperature prevails at the color filter pack drawer (Fig. 5) which is removable from the front.

Since the sound-printer aperture is

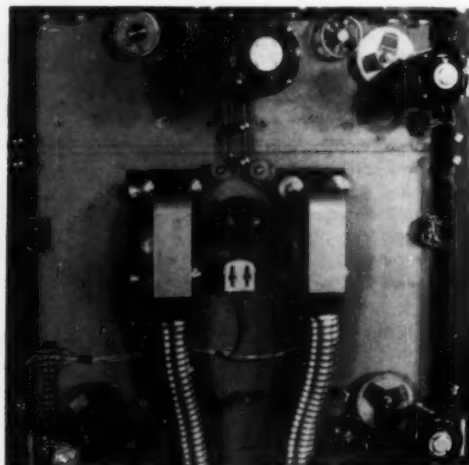


Fig. 4. Back of color positive printer panel—chain drive to printing sprockets; take-up motors and friction clutches.

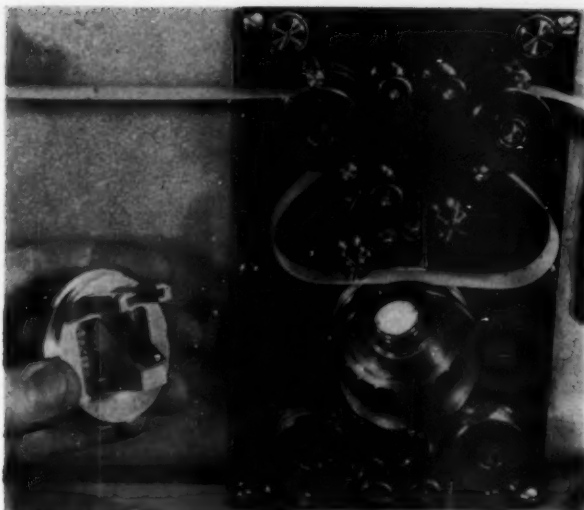


Fig. 5. Printer head with gate open and drum cover removed showing filter drawer above front-surface mirror.

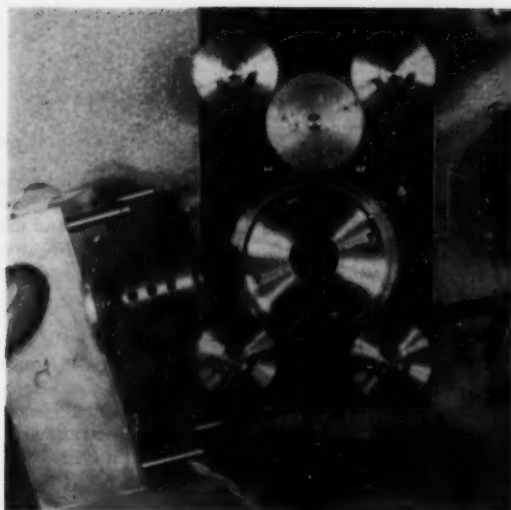


Fig. 6. Close-up with lamphouse removed from printer head showing condenser lens-tube which extends into hollow printer sprocket shaft.

narrow, the light is doubled by splitting the front-surface mirror and superimposing the two resulting beams.

Take-ups are handled with individual motors through friction clutches (Fig. 4). The rewind motors act as holdback tension with about 8 v d-c applied to the field winding. A built-in time-delay device applies the current for a few seconds after the machine is stopped. Otherwise there would be a consider-

able pile of uncontrolled film on the printing-room floor.

Printing Lamps

The intensities of the two printing lamps are controlled by a single Variac and d-c voltmeter. A high-grade voltage regulator and d-c rectifier are integral parts of the machine. The balancing of track and picture exposures is accomplished by means of neutral-density filters in the individual filter packs.

The total load of the seven motors and two projection lamps is under 8 amp so that it may safely be plugged into any wall outlet for operation.

The machine has given satisfactory performance and has been adequate for all requirements. More than 300 prints have been made from each of several color internegatives. There is no reason to believe that the internegatives will not be useful for as many more prints.

Proposed Constitution Amendment

TWO PROPOSED brief amendments to the Society's Bylaws were published on p. 548 in the August 1959 *Journal*.

A proposed amendment to the Constitution, considered and approved by the Board of Governors, is published here for consideration by the voting members of the Society. This revision will be discussed at the business meeting scheduled for the opening sessions of the 86th Convention to be held in New York on October 5. This amendment will subsequently be submitted by mail to all voting members for return within 60 days of the mailing-out date. An affirmative vote of two-thirds of the valid ballots returned, subject to the time limitations, is required to carry the amendment, provided one-fifteenth of the duly qualified members shall have voted within the time limit specified above.

The revision proposed here is with respect to Article VII, "Board of Governors." The Constitution and Bylaws were last published in the April 1958 *Journal*, Part II. Reprints are available from Society Headquarters.

Article VII which consists of one paragraph is reprinted below with italics

indicating where changes are proposed, in this order: a deletion, a substitution, a transposal, a substitution and a deletion.

ARTICLE VII

Board of Governors

"The Board of Governors shall consist of the President, the Past-President, the six Vice-Presidents, the Secretary, the Treasurer, the *Section Chairmen*, and twelve elected Governors. An equal number of these elected Governors shall reside within the areas included in the Eastern time zone; the Central time zone; and the Pacific and Mountain time zones. The term of office of *all* elected Governors shall be for a period of two years."

The proposed amendments will make this paragraph read as follows:

"The Board of Governors shall consist of the President, the Past-President, the six Vice-Presidents, the Secretary, the Treasurer, and twelve Governors elected by the membership of the Society. An equal number of these elected Governors shall reside within the areas included

within the Eastern time zone, the Central and the Mountain time zones, and the Pacific time zone. The term of office of these elected Governors shall be two years."

It is further proposed that the following two paragraphs be added to Article VII:

"In addition, when a Section contains 14% or more of the total membership of the Society, the Chairman of that Section becomes ex-officio a member of the Board of Governors. The total membership figure used shall be as of the close of the preceding year.

"In addition, up to five Governors-at-Large may be elected by the Board of Governors. These Governors-at-Large are to rectify professional and/or geographic inequities, and they shall each serve for a term of one year or that part of the yearly term remaining at the time of their election. Each year, immediately following the National Elections, the Board of Governors shall determine whether any Governors-at-Large are required. If so, the National Nominating Committee shall be directed by the Board to nominate at least two candidates, properly qualified, for each Governor-at-Large to be elected."

An Automatic Loop Printing System

By MARIO CALZINI

An automatic loop printing system for 35mm motion-picture films in color and black-and-white has been developed. After a predetermined number of prints, the next negatives are brought into place automatically and printing is resumed after the splicing of the new sound and picture reels. Negative magazines are automatically adjusted for length during the printing and the replacing of the new films.

MANY FACTORS INFLUENCED Tecnostampa Laboratories in Rome in the design and production of this automatic film printing system. First, an increase in the demand for color prints required more productive equipment. Second, a decrease in the supply of skilled labor, and third, a reduction in the selling price of the printed film required more automatic equipment. Moreover, rapid production of prints was particularly required since in Europe any foreign pictures are printed from duplicate negatives which have to be sent from one country to another to print local versions. The shorter the time a duplicate negative remains in each country, the better it can be exploited. Since Tecnostampa Laboratories are located in the heart of the city where building space is limited, it was decided to increase productivity instead of adding additional machines.

For these reasons a Printer Loop

System was designed which is suitable for making a number of prints continuously from each reel. Conventional loop devices show a drawback; an Italian version requires approximately thirty copies (occasionally as many as fifty), therefore requiring replacement of the negative after thirty prints and the time-consuming task of adding leader to adjust loops.

In order to reduce the manual operation the splice between raw positive reels must be made during printing by the printer operator and cleaning of the picture and sound negatives should take place during the printing. The machine was carefully designed to prevent damage to the negatives during the printing process.

The present printing system, improved through a number of operation tests, meets the design requirements and particularly is characterized by:

- (a) moderately high printing speeds,
- (b) rapid and automatic replacing of negative reels,
- (c) positive splicing during printing,
- (d) negative cleaning during printing, and

- (e) safeguarding of negatives from damage.

Loop Operation

Figures 1 and 2 show the equipment from an angle to the right and to the left, respectively. The picture negative magazine is on the right end, the sound negative magazine is on the left, and the continuous printer is in the center.

Figure 3 is a general scheme of the machine.

The positive elevator is placed between picture negative and printer (close left of the printer); both the rewinders, which allow picture negative replacing, and the splicer are placed below.

Both rewinders for sound negative replacing and splicer are placed at the right side of printer.

The Printer (Fig. 4) in the center of the equipment is a CP6-35 machine originally manufactured by Houston-Fearless. This printer has been modified to meet requirements. Printing speed has been increased up to 113 ft/min. The printer has been fitted with an automatic light change, operating a stationary matte, which adjusts the light beam and contains the color correction filters.

The machine is also fitted with a highly efficient optical system, demanded by the high printing speed; other devices contribute to stability and uniformity of speed. Compressed-air jets maintain clean printing gate edges, and padded

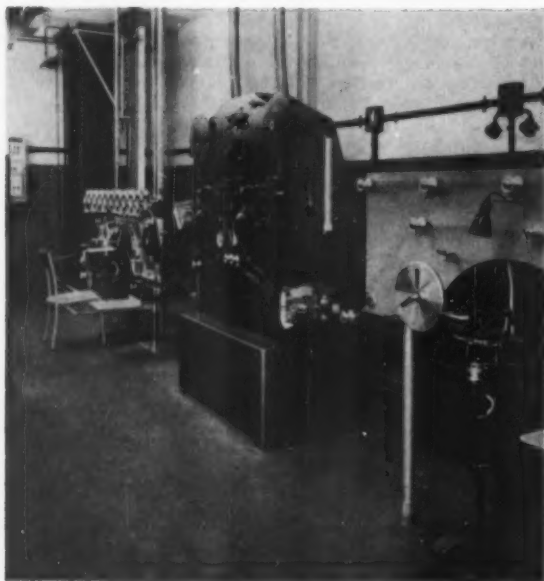


Fig. 1. The printing equipment from a right angle of view.

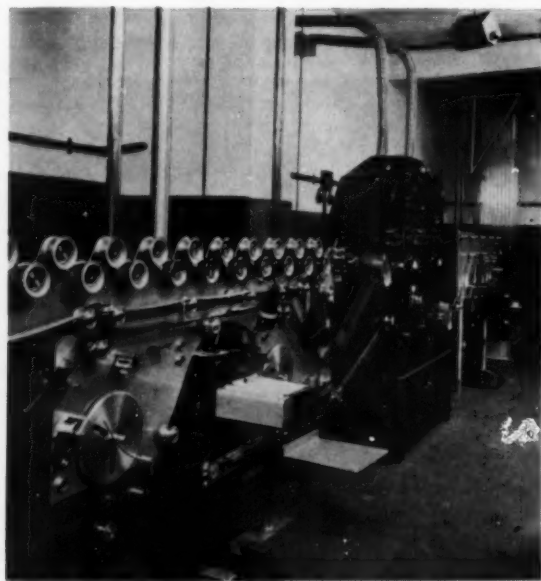


Fig. 2. A view from an angle to left of the printing system.

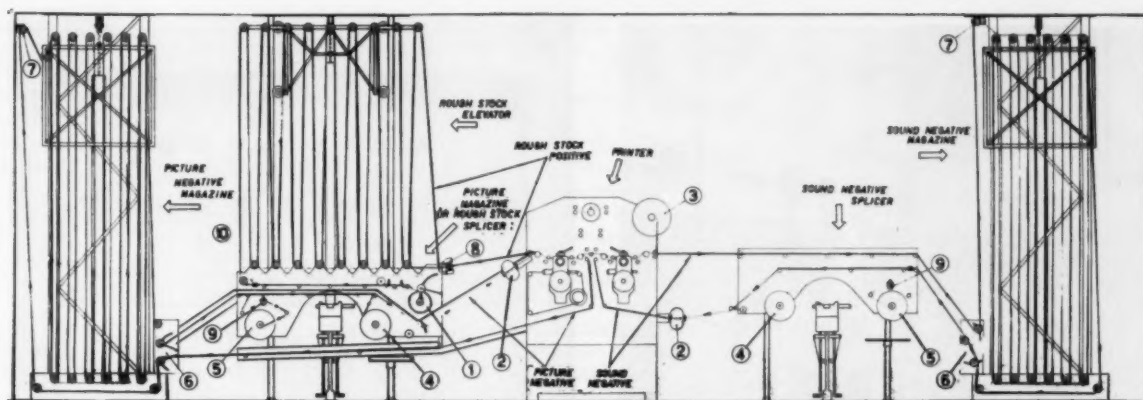


Fig. 3. General schematic of the printing system.

rollers furnish very good contact between negative and positive. A torque motor drives the exposed positive take-up.

Figure 3 shows the path of film during loop operation. The picture negative, as soon as it is out of the printer, is led below the left splicer and into the picture negative magazine. From this magazine it is led above the splicer, enters the dust-removing device (2) and is again ready to print. Sound film has a similar path. As soon as it leaves the printer it is passed above the sound splicer and enters its magazine. Out of this, it is passed above the splicer, through the dust-removing device (2) and again enters the printer. In this circuit only the printer has sprockets.

Particular attention has been given to prevent both sound and picture negatives from break danger on starting. This arrangement also provides a soft running. Close in and out of magazines some rollers (at (6) in Fig. 3 and shown in Fig. 5) damp and adjust the film strain. They connect with electronic devices which ensure a uniform tension which is lower than a predetermined limit figure. Also, before entering magazines, film is threaded on a roller (at (7) in Fig. 3), in connection with a motor that increases the tension upon starting, namely just at the moment in which the system has to overcome the inertia of the starting of rollers and the mass of the film. The motor operates when the tension in the path from printer to magazine decreases. Electronic controls are in the container shown in Fig. 6.

Magazines operate by the bottom-drive principle and top roller trees are supported by a springing arrangement to distribute any sudden increase in local tension. The trees are equipped with little motors operated by a tension control in the film outgoing from the magazine, namely in the path from magazine to printer.

This arrangement allows the control of any dangerous tension shift which may occur upon starting the mechanism or for something accidental. Should these

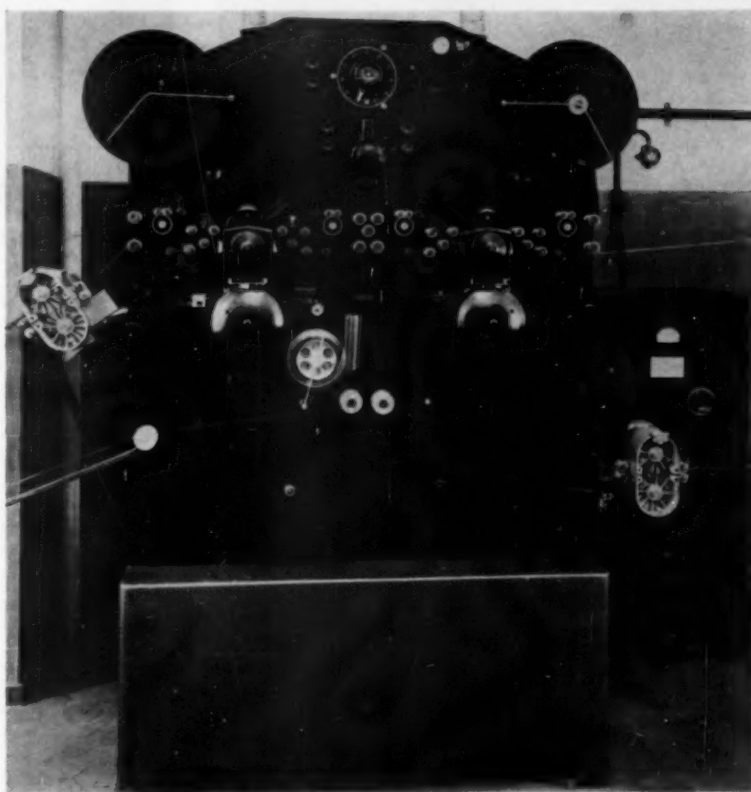


Fig. 4. Close-up of the CP6-35 machine, originally manufactured by Houston-Fearless.

automatic devices fail, special contacts are provided which stop the printer to prevent film damage.

Raw positive is placed on the spool at (1) in Fig. 3. It is passed from right to left over the picture negative splicer and through the stop clips (10) which normally are open. Then it is passed back among the positive elevator rollers and, after passing through the alpha ray static brushes (8), enters the printer, traversing the picture printing gate and then the sound printing gate where it becomes exposed. It is then wound up on the spool (3). The positive elevator is normally

down, but when the raw positive reel length exceeds the maximum elevator capacity an electromagnetic release is operated and the elevator rises to the maximum position. As the end of the positive reel approaches, clips (10) automatically grasp the film. A new positive reel is now placed on the spool (1) and the end is now spliced with the new reel. Seventy seconds are available to make the splice as the printer takes up the length of film contained in the elevator. When the elevator attains its lowest position, it automatically releases the clips.

The mechanism is also provided with

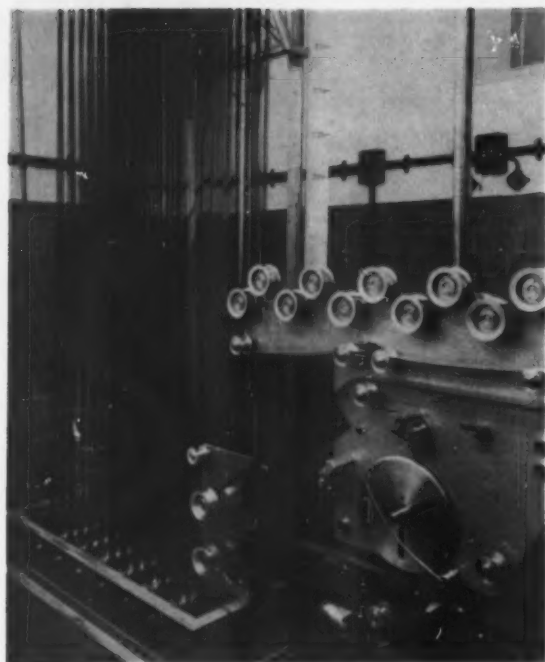


Fig. 5. Rollers and tension control system.

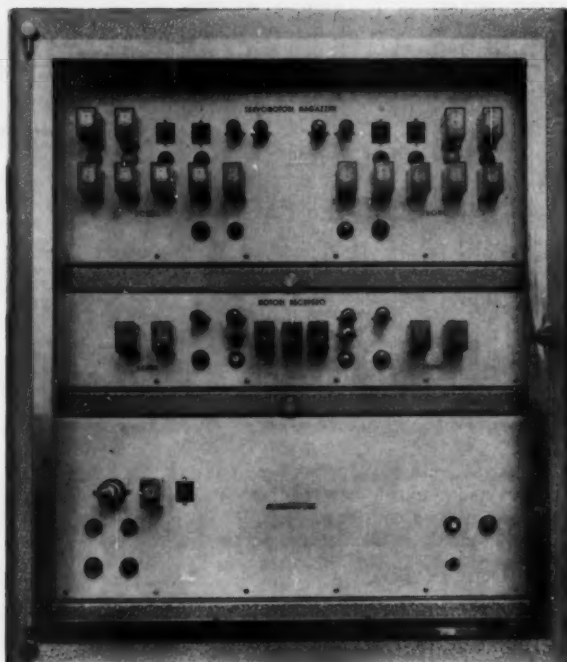


Fig. 6. Electronic controls panel.

devices which prevent too high a tension on the positive. One of these consists of a special control that gradually brakes the elevator when close to its maximum height.

At the end of each print, namely when the negative has made a complete cycle, the printer stops. As the light-change control band may have the ends spliced together in a loop, there is nothing else to do but to remove the positive from spool (3) and attach the film to a new core. Occasionally it is recommended to check the synchronization between picture negative and sound negative. To do this, the padded roller at the printing gate is raised and sync marks on the film checked for position at the printing gate.

Negative Reel Replacement

As soon as all the prints have been made from a pair of negatives (one sound, one picture) this has to be replaced by a second pair, as follows:

After printing a set of reels the printer stops and the two lengths of negative, above the splicers, present the splice between head and tail of the reels.

The splice is cut and the end from the magazine is attached to the rewinder (5) after being passed over the driving sprocket (9). The other end is spliced (according to the sync marks) with the new reel to be fed into the printing system. The reel is placed on the spool (4).

As soon as this has been accomplished on the picture side and on the sound side, the control light band is replaced in the printer by another for the new negative reel and, if necessary, the soundtrack

printing light is changed. The printer is now ready to print the first print from the new reel. During this printing the film from the spool (4) is passed through the brushes (2), is printed and then enters the magazine.

Out from this magazine the old film is wound on the rewinder (5).

An automatic system controls the driving sprocket in such a way that before the entire new reel has been printed, all the preceding reel has been wound on the spool (5) and the rewinder stops automatically at the moment at which the head of the reel being printed arrives at the rewinder.

If the reel (9) speed is higher than printer speed (this occurs any time the reel-in is shorter than the reel-out) the negative magazines lower gradually during the printing. When the reel (9) speed is lower than printer speed (this occurs any time the reel-out is shorter than the reel-in) the magazines rise gradually. When the driving reel (9) stops, magazines rise or continue to rise to take up the film fed from the printer. This takes a very short time because the printer stops immediately after having made the first print.

When the printer is stopped, head and tail of the printed reel are close to the left and right of the splicers and the magazines are in a position corresponding to negative length. Picture reel head and tail are spliced together, sound reel head and tail are spliced together (according to sync marks) and the printer is ready for loop printing operation.

These prevention and control devices

are operating during the negative reel replacing.

If two operators simultaneously make the splices, one on the picture side and the other on the sound side, the new reel replacement takes from one to two minutes. This time is employed to make the splices and to adjust the negative tail end on the sprockets and rollers.

For only one print from each negative reel, not arranged as a loop, the lost time is less than that necessary for threading a conventional printer.

Work Procedure

To get the maximum efficiency from the equipment, the following work procedure has been outlined.

Tecnostampa Laboratories have another printer, a modified Houston Fearless, like that in the loop system. This machine is threaded in the conventional manner.

After preliminary printing tests, the whole picture is printed in this machine. After the first print, color and light corrections are made and a second print is produced. If necessary, a third print is made to obtain an answer print according to the customer's taste.

Subsequently, the work is passed to the loop system and the required number of copies of the film printed reel by reel.

Conclusions

Starting on December 15, 1958, the loop system has made release prints and at the end of a year over 100,000 meters of color film have been printed; two operators were employed for eight hours

per day. The equipment is also suitable for black-and-white prints. At present, two operators are employed for the first seven hours and two others for the second seven hours in the day; 20,000 meters of film can be printed in 14 hours of work. The most important advantages are:

(a) a remarkable reduction in positive waste, due to a continuous use of emulsions reel by reel; and

(b) an optimum rationality of the work that can be planned, even a week before.

The loop system was found to be equivalent to three or four conventional step printers. Each conventional printer requires an operator and three or four printers, almost an additional operator for positive splicing and an operator for cleaning the negative. It can easily be seen that two operators in the loop system replace from five to six in the conventional system.

Compared to the up-and-down printing system used in some laboratories, it

can be seen that the loop system is more encumbering, but has some evident advantages.

(a) Threading time is remarkably reduced.

(b) Positive leaves the printer always wound in the same direction. In the up-and-down printing system, each alternate reel comes out wound in the opposite direction, so it is necessary to rewind half of the number of reels before developing to present the same side of the soundtrack to the redeveloping device.

(c) During rewinding so many reels, mistakes and extra costs might occur.

(d) Negative rewinding can damage the film surface and fix dust particles in the emulsion. After each tenth print it is frequently necessary to stop the printer and clean the negative. In the loop system such rewinding is not required and dust is easily removed from negatives by means of the very low pressure from rotating brushes.

Acknowledgments

This equipment has been designed by the writer after visiting a number of laboratories in the United States in 1957. The courtesy of laboratory managers allowed a very close examination to be made of the high-speed work systems.

Acknowledgment is due to Consolidated Film Industries and to Sidney Solow, Vice-President. The designs of some parts of the equipment were inspired by Consolidated Labs; advice and suggestions from technicians of Consolidated Labs were very useful for designing the other parts.

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A Versatile Multiple-Unit Re-recorder

By G. R. CRANE and H. A. MANLEY

The Re-recorder is a machine designed for small studio use and incorporates in one cabinet up to four magnetic reproduce units driven by a common motor. The units may be any combination for either 35, 17½, 16mm or ½-in. perforated film, one of which may be equipped for magnetic recording and a second for optical reproduction. Transistorized amplifiers of new design have been incorporated.

THE RE-RECORDING process in the professional motion-picture studio is certainly one of the major elements contributing to the quality of the final product. For more than a decade, the film reproducers used in the re-recording operation have been mounted in attractive rack cabinets providing excellent film motion and equipped with special features to facilitate rapid operation in the interest of conserving operating time.

The early¹ re-recorders were, of course, used only with optical tracks and later developments² accepted both magnetic and optical tracks with several film widths and film speeds. These machines met all of the performance requirements considered desirable at the time of their development. However, the typical studio installations, which included up to 30 or 40 machines, represented a very substantial investment and space requirement.

With the growing television demand for motion-picture production on somewhat restricted budgets and frequently limited plant space, the need for more compact and less expensive equipment became apparent. To meet this need, Westrex has developed the RA-1621-type equipment which permits housing up to four complete reproducer units in one cabinet, but without sacrifice of the high quality of performance, reliability and convenience expected in the re-recording operation.

Mechanical Details of Equipment

The film-pulling mechanisms as well as the transmission equipment and controls are contained in a single cabinet as shown in Fig. 1. The number of film mechanisms may consist of from one to four units depending on the users' requirements. The top panel as shown in the figure contains the controls for the

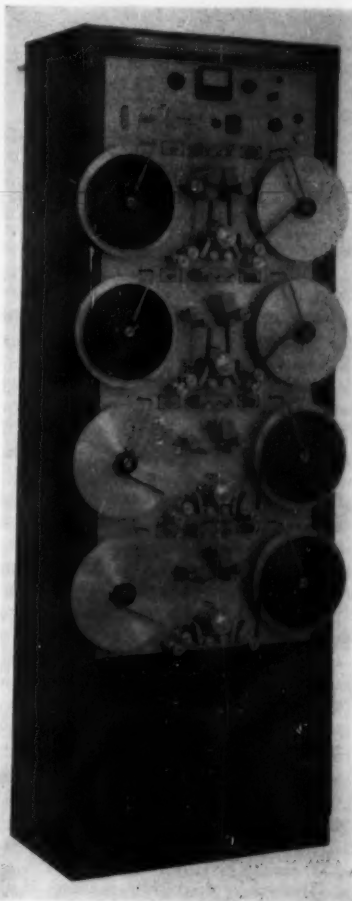


Fig. 1. Westrex RA-1621 Rerecorder, consisting of four magnetic reproducers, the top unit being equipped for recording.

Presented on May 6, 1959, at the Society's Convention in Miami Beach by E. A. Dickinson for the authors, G. R. Crane and H. A. Manley, Westrex Corp., 6601 Romaine St., Hollywood 38. (This paper was received on June 19, 1959.)



Fig. 2. Front view of the film-drive mechanism unit.

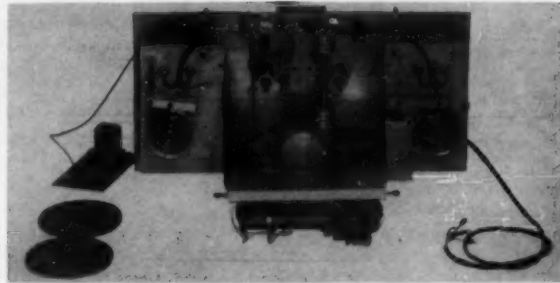


Fig. 4. Rear view of the film-drive mechanism unit, with the center equipment panel folded down, and the flywheels removed.

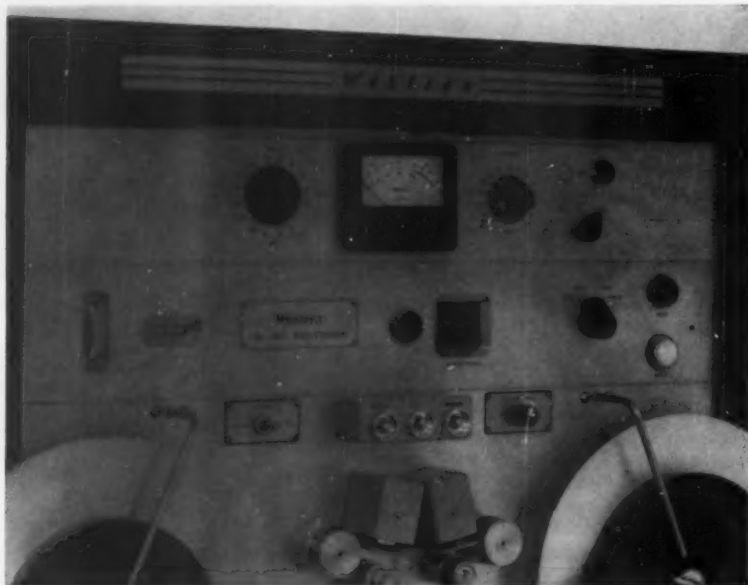


Fig. 3. Close-up of controls.

electronic equipment, and the second panel from the top contains the main-drive motor controls and a mechanism-driven footage counter.

A single motor drives all of the mechanisms in any one cabinet; however, a means for decoupling any one of the units from the main drive is provided. Each unit is equipped with independent fast rewind or fast forward film winding facilities with the film removed from the sprocket. Each film-pulling mechanism has been designed as a complete unit except for the main drive. This method provides unusual flexibility for the user since he may add to an original low-cost installation of one or two units any number up to four units in the same cabinet as his requirements increase, without demanding more floor space in his plant. An optional arrangement provides for independent main-drive motor and control facilities for each of two units in a single cabinet.

Film-Drive Units

The individual film-pulling mechanism unit is shown in Fig. 2. This basic

unit may be equipped to handle either 35mm, 17½mm, 16mm or PerfoTape film at speeds of 90, 45 or 36 ft/min. These four film sizes and three film speeds may be used in any combination in a single cabinet using one common main-drive motor. The film path and filter system used is of the tight-loop Davis Drive³ type to provide optimum film motion. The total flutter content at the sound translation point due to film motion with 35mm film operating at 90 ft/min is less than 0.08% rms. The flutter performance with the other possible film widths and film speeds is comparable, depending upon the particular film and speed. Air damping of the filter rollers has been employed in this application for ease of maintenance and reliability.

The film sprocket is driven from a common drive shaft through a gearbox where the required film speed for each unit is obtained by the proper set of interchangeable gears. A knob on the front of the film sprocket serves as the control for disconnecting that particular film transport from the common

drive shaft. Separate torque motors are employed for take-up and rewind duty due to their high reliability, smoothness of operation and minimum film abuse. Air-damped compliance rollers are provided at the take-up and feed reels to absorb any shock to the film that might occur during a fast start with a synchronous main-drive motor, or if a loose film loop is present after threading the machine. In addition, these rollers operate as film run-out automatic controls, disconnecting the power to the torque motors and applying the mechanical brakes when the film runs out, either during normal operation or high-speed forward or reverse film winding. A switch located on the front panel reverses the torque of the rewind motor to accommodate either A or B wind film.

All of the torque motor switching relays and torque control resistors for each unit are contained on a central hinged plate between the two motors. This assembly is hinged to provide ready access to parts mounted on the back side of the main panel. It may be removed completely by disconnecting the three plugs and sliding the panel off its hinge pins. Each torque motor is equipped with a mechanical brake. These brakes are "On" when there is no power supplied to the torque motors. Both sets of brakes are released simultaneously by a common a-c solenoid during operation. This solenoid is immersed in oil to damp the usual chatter of an a-c solenoid, to prevent the impact of the armature at closure and to avoid the sudden application of the brakes and its consequent possible abuse to the film.

Versatility in Application

The extreme versatility and flexibility of this basic design is seen in the variety of film widths accommodated: 35mm, 17½mm, 16mm or PerfoTape operating at any of the following speeds of 90, 45 or 36 ft/min, and arranged in any combination of these film sizes and speeds in one cabinet. The basic unit is equipped for reproducing standard magnetic sound records. However, in addition, it is readily adaptable to

perform the following functions: magnetic recording on any of the four film sizes mentioned above; optical reproducing of either 35mm or 16mm optical sound records; or accommodation of any two of the above units in a single cabinet with separate motor drives and controls.

A special unit for production transfer duty is also available which consists of any two of the above film-mechanism units in one cabinet. One unit is the magnetic recorder, the other being a reproducer equipped with special facilities. These include a film-driven footage counter and provision for variable speed, fast forward operation of the film up to 4 times normal speed without the necessity of unthreading the film from its normal operating path. During the fast operation the film is lifted from the magnetic heads to reduce head wear.

With the film clear of the sprocket path, the high-speed forward or high-speed rewind operation using 1000 ft of 35mm film is accomplished in approximately 45 sec.

Controls

The high-speed forward or rewind operation is controlled by three momentary pushbutton switches on the front of each mechanism panel as seen in Fig. 3. The switch button on the right is the "forward" control, the one on the left is the "rewind" control, while the one in the center is the "stop" control and operates regardless of the direction of film travel. The forward and rewind control buttons may be operated alternately in rapid sequence to jockey the film back and forth while searching the film for a particular cue mark. When it is located, a simple touch of the "stop" button immediately stops the film travel. The mechanical brakes on the torque motors are so designed that a loose film loop is never produced regardless of film speed, direction, reel-core diameters or the amount of film on each reel when the stop switch is operated. When the film rewind is completed in either direction, or if an open splice occurs during fast winding, both torque motors are automatically disconnected and the brakes applied.

The power control panel (the second panel from the top in Fig. 3) contains power line circuit breaker switches and associated pilot lamp, and a motor control switch for either "Synchronous," "Bus 1," "Bus 2" or "Off." A pair of pilot lamps indicate the motor bus to which the main drive is connected. The mechanically driven footage counter with manual reset to zero appears on this panel.

Motors

During normal operation the torque motors are energized from the main-drive motor circuits and receive power

when the main-drive motor is operated. A rotation sensing device is located on the common main-drive shaft. This device keeps the torque motors energized and the brakes released until the mechanism has stopped rotating, thus preventing any abuse to the film due to brakes being applied when the film sprocket is still rotating. It also prevents any loop of film being thrown on the take-up side, as the film is under tension until rotation has ceased.

The main-drive motor may be a 3-phase synchronous motor, distributor interlock or a composite motor which provides interlock from start either from a distributor or from other composite-type motors in the system with the alternate choice of 3-phase synchronous operation. The drive from the motor is through a timing belt to a vertical common drive-shaft assembly consisting of the gearbox shaft of each mechanism unit, coupled with a stub shaft to each unit gearbox below as shown in Fig. 4.

Transmission Equipment

The reproducing facilities are designed to operate into the new transistorized RA-1627-type Rerecording Mixer which is described in an associated paper.⁴ Similarly, the recorder, which forms an optional part of the multi-unit re-recorder is designed to operate from the output of this transistorized re-recording mixer. All of the electronic units of the re-recorder, including magnetic and optical reproduce-amplifier, headset monitor amplifier, bias oscillator and recording amplifier, are completely transistorized. The latter amplifier may be mounted optionally either in the re-recorder assembly or in the mixer. A power supply providing line and load regulated 28 v at 200 ma serves all of the facilities in the 4-unit re-recorder and mixer, and may be mounted in either assembly. Both the recording amplifier and the power supply unit are described in more detail in the paper on the mixer referred to above.

A simplified block schematic of all the transmission facilities is shown in Fig. 5. The output level is approximately -20 dbm from a fully modulated 200-mil magnetic track. This provides the optimum input level to the transistorized mixer.

The reproduce amplifier is a 3-stage unit. The 500-mh magnetic reproduce head operates directly into the base of the first transistor through an isolating tantalum condenser. The input circuit is designed for minimum transistor noise when working from an impedance corresponding to this magnetic head. The head is capacity-resonated for maximum response at 10 kc which gives an increase of 5 db at this frequency. An adjustable potentiometer permits adjustment of high-frequency response

from the film. Low-frequency pre-equalization corresponding to the ISO-SMPTE 16mm characteristic, the Westrex low-frequency characteristic or a flat low end can be obtained by appropriate strapping of an equalizer between the first and second stages. A gain control between the second and third stages provides adjustment to the nominal -20 dbm output level for the various types of track. The output transformer provides either a 50-ohm or 600-ohm output. The amplifier provides approximately -15 dbm output from a 200-mil track recorded at the 3% film distortion level.

The signal-to-noise ratio under these conditions is approximately 60 db. The overload level is approximately 1% at -6 dbm. Feedback and stabilization circuitry in each stage provide essentially constant performance over a temperature range up to approximately 55 C. The amplifier draws approximately 3 ma from a 28-v d-c supply. Components are mounted on one flat epoxy glass plug-in board and space is provided for adding an optional output stage when a nominal 0-dbm rather than a -20-dbm output is preferred.

With the usual -20-dbm output type and when the unit is being used as a headset monitor amplifier under recording conditions, a separate transistorized booster amplifier may be added to raise the level to a nominal 0 dbm.

The recording input is normally at a -20 dbm level if the recording amplifier is within the re-recorder assembly or +16 dbm if the recording amplifier is external. The high-frequency recording pre-equalization amounts to approximately 9 db at 10 kc for 16mm and 45-ft/min recording and 4 db at 10 kc for the 35mm 90-ft/min recordings.

The general recording circuitry and the bias oscillator are very similar to those which have been previously used and described.⁵ The overall performance also is quite comparable with that obtained with the highest-quality vacuum-tube equipment. The overall record-reproduce frequency response is flat to approximately 9000 c in the 16mm version, 10,000 c in the 45-ft/min version and 12,000 c in the 90-ft/min version. The overall signal-to-noise ratio is approximately 60 db for signals recorded at the 3% distortion point on the magnetic medium.

One fact particularly worthy of mention is the high degree of noise-interference reduction which was achieved. Noise interference was inherently a greater problem in this equipment than in the conventional single-unit machine because: first, with four transports, any one of which could be independently started, stopped and rewound at high speed, there were an unusually large number of switch and relay contacts; and second, it was specified that it

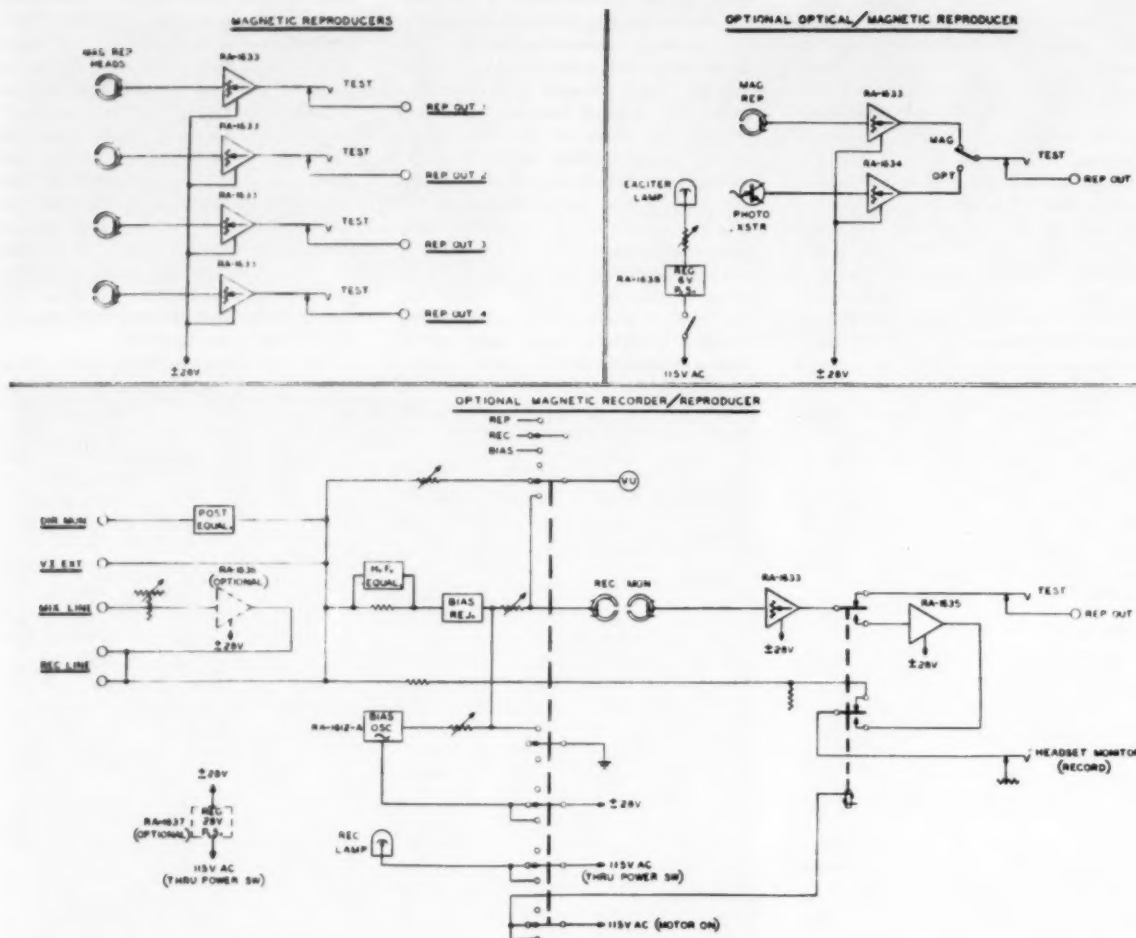


Fig. 5. Simplified block schematic of the basic machine and optional facilities.

must be possible to re-record from one or more transports while others are being used for fast winding or rewinding of film, without introducing switching transients into any reproducing circuit in operation.

Switch arcing was first greatly reduced by optimum choice of condensers across the contacts. There still remained significant click noises which found their way into the reproduce head, amplifier input circuit and amplifier power supply circuit from transient ground currents flowing in the equipment cabinet frame. These residuals were ultimately eliminated by first electrically isolating the reproduce-head mounting, and the chassis of the 28-v supply feeding the reproduce amplifiers. Then a shield was placed between the relay assemblies and the reproduce amplifiers.

All of these items were then connected to the grounded side of the 28-v supply which was also system-ground. This ground was then carried separately from the cabinet frame to a water-pipe ground. It was then possible to carry on any of the switching operations without interference into any of the reproduce-amplifier circuitry.

Conclusion

The multiple-unit re-recorder described in this paper offers considerable flexibility in re-recording operations, especially in smaller studios where capital outlay for equipment and space may be controlling factors. At the same time there is no sacrifice of operating excellence ordinarily associated with standard single-cabinet-type machines found in most motion-picture sound

departments. The optional high-speed feature available for a 2-unit transfer assembly adds to the speed and efficiency of routine recording transfer operations.

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A Low-Cost Transistorized Re-recording Mixer

By G. A. BROOKES, G. W. READ
and E. W. TEMPLIN

A compact table-mounted six- or eight-input, single-channel re-recording mixer has been designed for small studio application. Transistorized modular subassemblies provide each mixer circuit with gain control, program and midrange equalizers; an additional transistorized module includes an overall gain control and test oscillator. Complete mixer console facilities have been incorporated. Highly reliable operation and professional quality performance comparable to that required in major studios has been achieved.

THE RA-1627-type Mixer is a compact, table-mounted, completely transistorized re-recording mixer. It was designed particularly for use with the Westrex RA-1621-type Re-recorder which is the subject of an associated technical paper.¹ However, it is applicable to re-recording systems in general where a nominal input level of -20 dbm and a nominal output level in the range of -20 to +16 dbm are to be accommodated. In addition, the design is based on a number of electronic modules, which may be readily incorporated into custom systems to provide the number of mixer inputs, mixer groups and output channels required in any particular installation.

By effecting economies such as the use of transistors, elimination of transformers where possible, use of low-cost standard carbon potentiometers as attenuators and equalizer controls, and use of hardwood rather than metal for the case, considerable saving in cost has been achieved, while maintaining performance which amply meets major studio motion-picture requirements.

General Description

One of the standard mixers, the RA-1627-A, is shown in Fig. 1. This unit has six mixer inputs and a single-channel output. It is 13 in. high, 16½ in. deep

and 32½ in. wide. The height and depth are constant for all versions of the RA-1627-type Mixer, but the width varies depending on the number of inputs and the number of optional accessories provided. The shell has an attractive gray wrinkle finish which is very similar to that obtainable with the more expensive metal enclosures.

The RA-1627-C Mixer with eight inputs is 8 in. wider. Other versions have been constructed with added facilities, one of which will be described later.

Across the bottom of the larger of the two sloping panels are located three mixer controls on the left, the master volume control in the center, and the remaining three mixer controls on the right.

Above each mixer control are the low-frequency and high-frequency equalizer controls for that mixer channel. The low-frequency equalizer control provides continuous variation from 12-db drop to 12-db boost at 50 c (cycles per second). The high-frequency equalizer control provides 12-db drop to 12-db boost at 10,000 c. Above each pair of equalizer controls are two switches. The three-position switch provides for switching the equalizers in or out of the circuit without affecting the overall gain, and for cutting off the output of the mixer channel. The two-position switch and associated circuitry is optional, providing for the insertion of a midrange equalizer for dialogue which introduces a boost of approximately 5 db at 4500 c.

Each mixer, together with its associated equalizers, switches and transis-

torized circuitry for operation from the -20 dbm-input into the combined volume-control circuit, comprises one of the basic modules of the system.

The amplifier-oscillator is the second of these modules. This includes the master volume-control, talk-back microphone and switch, a test oscillator and switch, and transistorized circuitry which operates from the combined outputs of the individual mixer modules and provides a -20-db output.

Two other modules, both optional units, are the RA-1636-A Recording Amplifier which provides a +16-db nominal output from the -20 dbm output of the amplifier-oscillator module and the RA-1637-A Power Supply which provides power to all of the transistorized circuitry.

All of these modules will be described in more detail below.

The controls on the upper sloping panel are from left to right: a fader for the monitor system; V.I. and range control, film-direct monitor switch, compression meter for use with a remote compressor amplifier, selector switches for three-frequency high-pass and low-pass effects filters, and IN-OUT switches for radio effects and telephone effects filters.

Both the upper and lower sloping control panels are hinged to give access to the electronic components for maintenance purposes.

A jack field is provided on the front vertical surface. Also on this surface is a power switch and indicating lamp used when the mixer is equipped with its optional RA-1637-type Power Supply.

In Fig. 2 is shown a variation of the RA-1627-type Mixer, which has been constructed for a particular customer. This unit contains all the facilities noted previously and, in addition, controls for a Graphic Equalizer and an RA-1593-A Compressor Amplifier. These may be seen on the right of the previously described set of controls.



Fig. 1. The RA-1627-A Mixer.

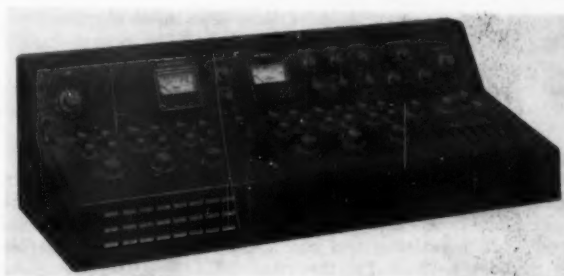


Fig. 2. The RA-1627-B Mixer.

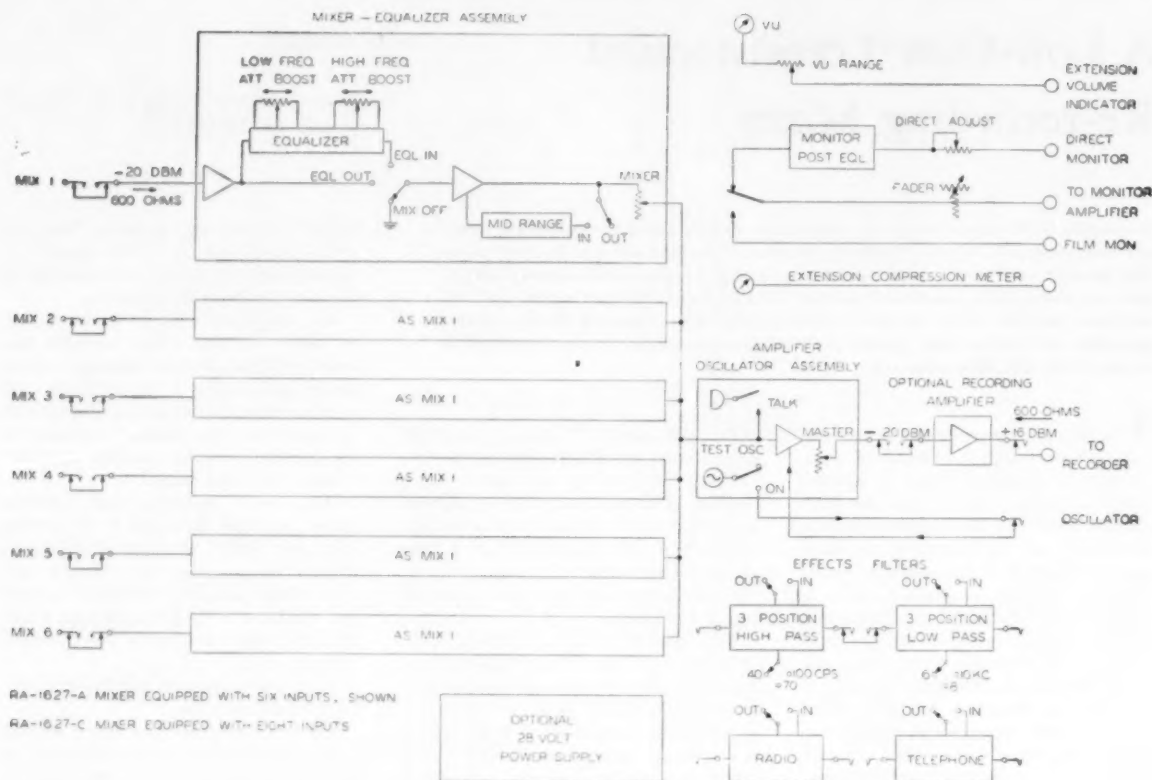


Fig. 3. Block Schematic of RA-1627-type Mixer.

Circuit Facilities

A block schematic of the RA-1627-type Mixer is shown in Fig. 3. Individual inputs at a level of -20 dbm are normalised through the jack field to identical mixer-equalizer modules. As previously mentioned, these contain the high-frequency, low-frequency, and midrange equalizers, the mixer gain control and associated control switches.

The outputs of the mixer-equalizers are combined in the low-impedance input circuit of the amplifier-oscillator module which, as previously described, contains the master volume control, the test oscillator and the talk-back facility. Its output appears on the jack field as the -20 -dbm, 600-ohm output of the basic mixer. However, for some system applications the optional RA-1636-type Amplifier, with 36-db gain, is included to increase the output to $+16$ dbm at 600 ohms. This level provides for the operation of a magnetic recorder such as that which is being described in the associated paper.¹

Included in the RA-1636-type Amplifier are facilities for providing magnetic-recording pre-equalization according to several standard curves.

The four effects filters provided have a 600-ohm impedance and also appear on the jack field so that they may be patched either into the input circuit of

an individual mixer or the combined mixer output.

The test oscillator, which is contained in the amplifier-oscillator assembly, is normalised through the jack field so that when the front panel oscillator switch is operated, the 400-c test tone is connected into the record line for line-up purposes.

In the event that the optional RA-1636-type Record Amplifier is included, direct monitor and vu input are local rather than being brought from the recorder. Also in this case post-equalization is included in the direct monitor line in order to compensate for the pre-equalization introduced by the RA-1636-type Record Amplifier.

Mixer Equalizer

Figure 4 shows the wiring side of the mixer-equalizer with the standard carbon potentiometers used for the equalizer controls and mixer gain controls. Since these potentiometers carry no direct current, they introduce no objectionable noise and are expected to have long life.

Figure 5 is the schematic diagram of this unit. From this diagram it may be seen that the circuit contains two transistors. The input impedance is 600 ohms, provided by the parallel combination of resistor R11 and the input impedance

of transistor Q1. High-frequency and low-frequency equalization are accomplished in the coupling circuit between the two transistors. Midrange equalization is accomplished by a network in the collector to base feed-back circuit of the second stage. Temperature stabilization is obtained by the network R3-R5-R6 for the first stage and by the network R15-R17-R18 for the second stage. These networks also provide feedback to minimize changes in gain which would otherwise occur due to the production variations of transistors.

The mixer gain control is a carbon potentiometer, with log taper, on the

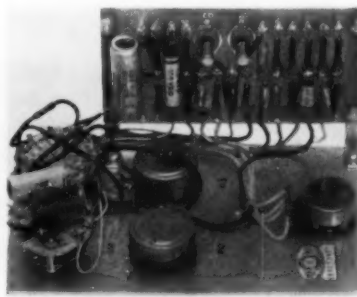


Fig. 4. The O-96075 Mixer Equalizer - Rear View.

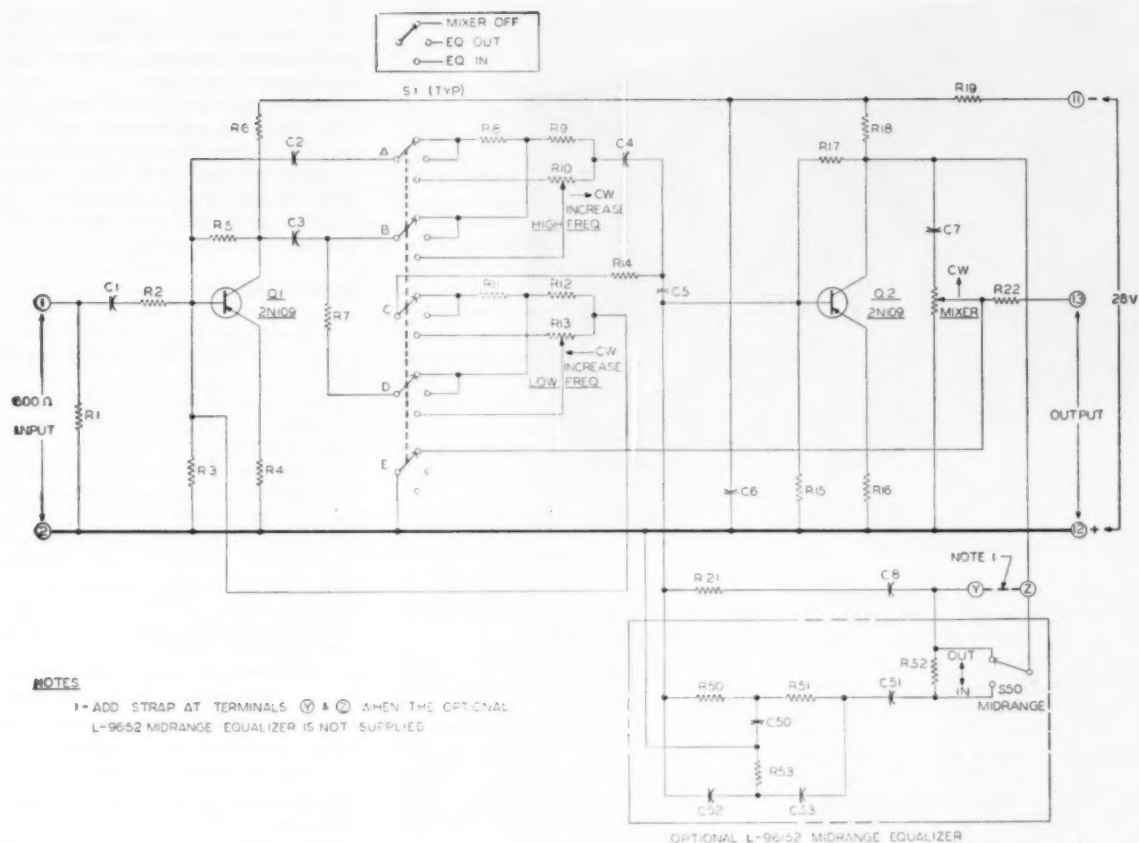


Fig. 5. Schematic of O-96075 Mixer Equalizer.

output of the second stage collector. The resistor R22 between this attenuator and the output terminal is the combining network resistor for the channel, i.e., the OUTPUT terminals 12 and 13 of the six or eight mixer-equalizers are paralleled and connected to the low-impedance input of the following amplifier-oscillator assembly. The mixer attenuator is located in the output circuit in

order that noise as well as signal will be attenuated by the gain control.

The equalization circuit used is of some interest; it is shown in simplified form in Fig. 6. The basic circuit is similar in some respects to that described by F. D. Waldhauer.² However, in our application we have eliminated the need for a tapped potentiometer for equalization control. In this circuit the output

from the collector of the first stage transistor Q1 is divided by the coupling network between drive current to the base of the second stage transistor Q2 and feed-back current to its own base. The greater the proportion of the current which is returned as feedback, the lower will be the gain of the amplifier. Hence, a frequency sensitive network in this coupling circuit serves to vary gain with

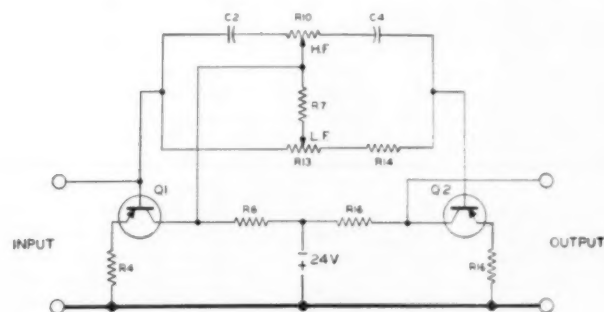
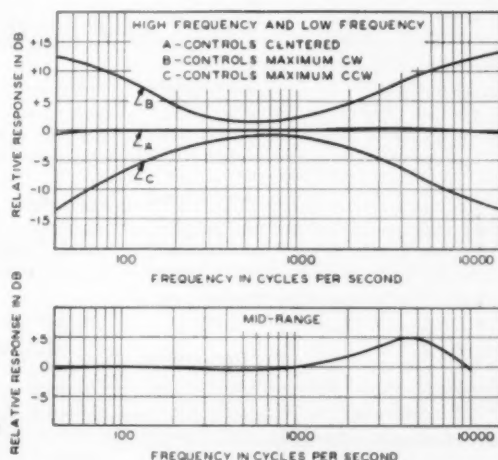


Fig. 6. Simplified Schematic of Equalizer Circuit.

Fig. 7. Response of Equalizer Circuits.



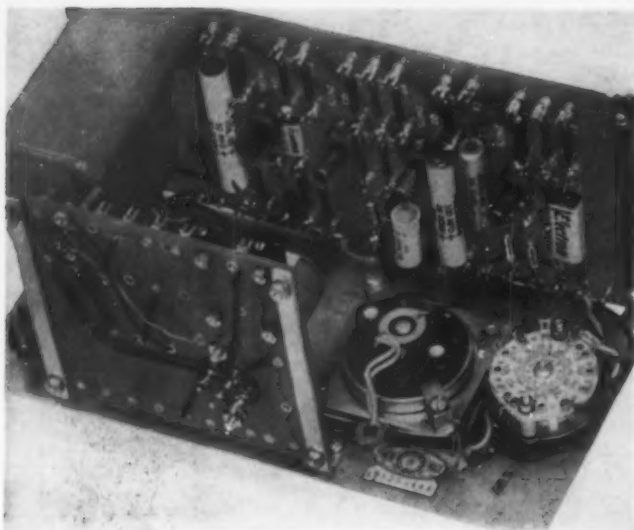


Fig. 8. The Amplifier-Oscillator.

frequency, i.e., to act as an equalizer. Analysis of the operation of this circuit may conveniently be divided into three frequency bands. In the range of approximately 400 to 1000 c, the division of current is determined primarily by the ratio between the two fixed condensers C2 and C4. These impedances are high compared to the high-frequency control R10, but low compared to the isolating resistor R7, with the result that the positions of the high-frequency and low-frequency equalizer controls have very little effect on the response over this frequency range.

For frequencies below 400 c, more current begins to flow through the path consisting of R7, R13 and R14 since the impedance of C2 and C4 is increasing. Under these conditions the division of

current between feed-back and forward paths depends upon the position of the low-frequency control R13.

For frequencies above 1000 c, most of the current flows through the circuit composed of C2, R10 and C4; the impedance of C2 and C4 decreases as frequency increases, becoming smaller than the impedance of R10. The division of current is therefore dependent on the setting of the high-frequency control, R10.

The response of the equalizer circuits is shown in Fig. 7. The upper response curve is that obtained with both equalizers in the position for maximum boost. The center curve is that obtained with both controls centered. The lower curve is the response with both equalizer controls set for maximum cut. Both con-

trols are continuously variable so that any combination of high-frequency and low-frequency response between the two extremes is possible.

The lower portion of Fig. 7 shows the fixed midrange equalization which is available. It may be seen to have a peak of approximately 5 db at 4500 c, which adds the "presence" equalization to dialogue when not provided in the original recording.

Amplifier-Oscillator

A photograph of a rear view of the Amplifier-Oscillator Module is shown in Fig. 8.

Figure 9 is the schematic of this sub-assembly. The oscillator portion uses a single transistor in a phase-shift oscillator circuit. The amplifier portion contains four transistors, all of which have temperature stabilization networks. Negative feedback is employed in all stages to minimize distortion and stabilize gain. The master gain control, again a standard carbon potentiometer, is located after the first transistor, which is the most favorable position with respect to signal-to-noise ratio and overload margin requirements. The input stage Q1 uses a low-noise transistor operating under conditions for minimum noise and employs a large amount of negative feedback. This feedback reduces distortion which would otherwise be present under the extreme operating condition of maximum mixer gain control setting and maximum equalizer boost combined with maximum level input. It also provides a low input impedance which reduces to less than 1 db the change in gain caused by cutting off all but one mixer channel.

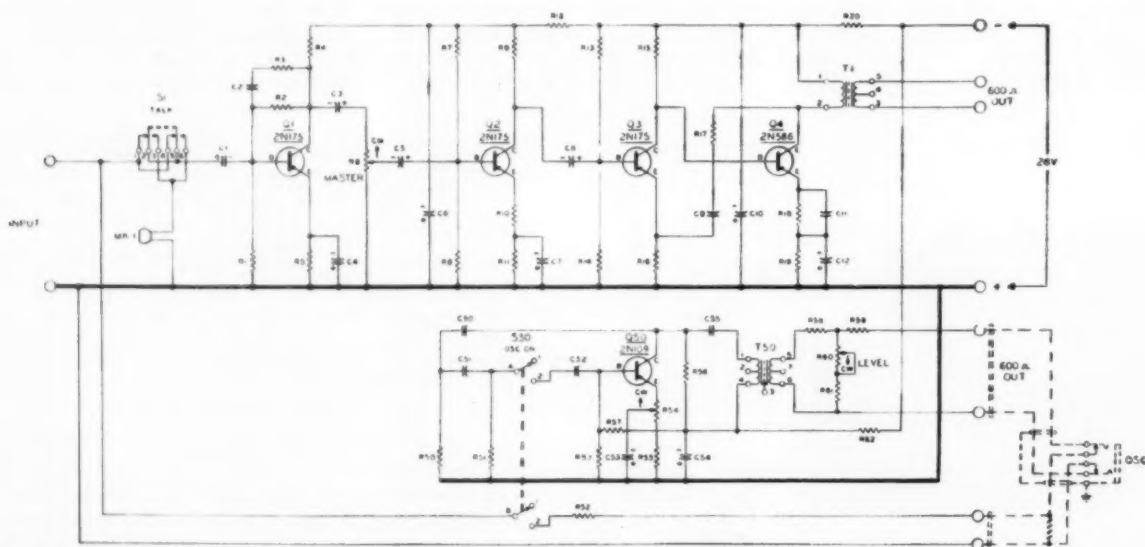


Fig. 9. Schematic of Amplifier-Oscillator.

Recording Amplifier

A 36-db gain amplifier, coded RA-1636, is supplied as an optional component of the RA-1627 Mixer in order to produce sufficient level (+16 dbm) to operate a magnetic record head such as the Westrex RA-1580-type. No input transformer is used. Its input is a 600-ohm resistive termination for the output of the amplifier-oscillator assembly previously described.

The circuit is conventional, consisting of two gain stages followed by a phase inverter, two push-pull emitter follower drivers and a push-pull output stage. Temperature compensation is provided in the base circuits of all transistors. Internal feedback is employed in all stages and from the output stage to the second stage in order to reduce distortion, minimize changes in gain with transistor replacement, and provide an output impedance of approximately 600 ohms.

A network is provided in the input circuit to provide recording pre-equalization for four different conditions:

- (1) no pre-equalization;
- (2) professional-quality low-frequency characteristics;
- (3) CinemaScope and 16mm standard low-frequency characteristic; and
- (4) 5 db of high-frequency pre-equalization.

Except for the equalization, the response is flat from 40 to 12,000 c. The output noise level is 75 db below the nominal 100% recording level.

Characteristics of the amplifier are essentially unaffected by temperature up to 125 F. Above this temperature the overload output level is decreased slightly; at 140 F, the 1% distortion point is at +21.5 dbm compared to +23 at room temperature.

Power Supply

The RA-1637-type Power Supply is an optional unit designed to supply all d-c power required by the RA-1627-type Mixer. The circuit comprises a full-wave semiconductor bridge rectifier followed by a two-section filter. The first employs conventional L-C elements whereas the second consists of an adjustable resistance followed by two series-connected "Zener" voltage-regulating semiconductors. The Zener voltage regulators are similar to gas-tube voltage regulators with several important differences, viz: (1) the dynamic impedance is much lower, being in the order of a few ohms; (2) they do not require a firing voltage in excess of the operating voltage; and (3) the regulation characteristic is better, i.e., there is less change in voltage from full load to no load.

Performance of the power supply is as follows:

Output voltage.....28 v
Full load current.....200 ma maximum
Ripple voltage.....3 mv
Output voltage variation,
no load to full load...0.75 v
Dynamic impedance...3 ohms or lower

The power supply, mounted on a 3½-in. panel, furnishes all power for a 6- or 8-input mixer, including the RA-1636 Record Amplifier, plus that required for the transmission facilities in an associated multiple-unit re-recorder equipped with three reproducer and one recorder sections.

Signal-to-Noise Consideration

The design aim has been to preserve essentially the same signal-to-noise ratio at the output of the RA-1627-type Mixer as is present in the input signals, which will be in the order of 60 db for a good magnetic reproduce channel.

This problem is more difficult of solution in a system using transistor circuits than in vacuum-tube circuits, due to the considerably smaller dynamic range, i.e., the difference between noise power and maximum undistorted signal output power. The noise power of a small low-noise transistor is slightly greater (2 to 6 db) than the noise power of an equivalent vacuum tube. The maximum signal-power output from the two is roughly proportional to the ratio of vacuum-tube plate dissipation to transistor-collector dissipation. These are, respectively, 50 mw for the transistor to 1 w for the vacuum tube. This is a power ratio of 20 to 1, or 16 db. Combining these two figures, the dynamic range available from a small transistor is something like 20 db less than from a small vacuum tube. Using a larger transistor with more signal-power output reduces the problem only slightly, as noise goes up along with signal-power capability.

The problem therefore is to establish operating points for the two gain-control circuits, mixer gain and master gain, such that under a reasonable range of operating conditions the operating level will be sufficiently above the noise level to provide adequate signal-to-noise ratio, and also sufficiently below the overload point to maintain acceptably low distortion.

An operating point has been chosen for the output stage of the mixer-equalizer such that a signal-to-noise ratio in excess of 70 db at normal operating level is attained.

The mixer attenuator is located at the output of this unit in order that this signal-to-noise ratio will remain constant as the output is attenuated and no noise will be introduced into the combined output from those circuits in which the attenuators are in the OFF position.

This location of the attenuator requires that the output stage of the mixer-amplifier not overload under conditions of maximum input and maximum equalizer boost.

Distortion is below 1% with maximum high-frequency and maximum low-frequency equalization, at the maximum input level of -20 dbm. This latter level should be established at the output of the reproducing amplifiers for program recorded at the 3% distortion level.

There is actually approximately 6-db margin from overload at the frequency extremes under these conditions, and in excess of 10-db margin for the middle frequencies.

Referring again to Fig. 9, the schematic of the amplifier-oscillator assembly (in whose input circuit the individual mixer outputs are combined), it may be seen that there is a stage of gain preceding the master gain control which is located in this unit. This is necessary to preserve the required signal-to-noise ratio in view of the loss in program level introduced by the mixer gain control and the combining network. This gain stage again introduces a dynamic range problem as it must be able to accept without appreciable increase in distortion the maximum level available from the mixer. In the event that maximum equalization is used with minimum attenuation in the mixer gain control, this may be as much as 32 db above the normal operating level. Under these abnormal conditions there is still a 10-db margin over most of the frequency range before distortion exceeds 0.5%; at the frequency extremes this margin decreases to about 4 db at the high end and 2 db at the low end. It should be pointed out that this is an extremely unlikely operating condition, and would require adding 32 db more than the normal amount of attenuation in the master volume control in order that the output power would not exceed 100% modulation at the recorder.

When operated at the recommended nominal value of 20 db attenuation in the master gain control, the noise at the -20-dbm output from the amplifier-oscillator assembly is -84 dbm, which is 7 db below the noise from two input channels, each with a 60-db signal-to-noise ratio.

Conclusions

Significant cost reductions have been achieved with this line of mixers and reliability equivalent to or better than that obtained with equivalent vacuum-tube equipment is expected.

References

1. G. R. Crane and H. A. Manley, "A versatile multiple-unit re-recorder," *Jour. SMPTE*, 68: 585-588, Sept., 1959.
2. F. D. Waldhauer, "Transistor tone control circuits," *Audio*, 41: 27-32, 88, Sept. 1957.

Magnetic Dual-Dubbing Reproducer

By CARL E. HITTLE

A new dual magnetic reproducer has been designed with an unusual arrangement of components. Two complete magnetic sound film reproducers are contained in one standard rack, enabling a substantial saving of floor space. A new film-drive mechanism used in the dual-dubbing reproducer is also described.

AT PRESENT, film-handling equipment for re-recording or dubbing is seldom designed specifically and solely for reproducing sound from magnetic film, and problems caused by space and maintenance requirements often arise. With these problems in mind, a magnetic sound reproducer has been designed which contains two complete magnetic sound film reproducers in one standard rack. Four of these dual dubbers lined up together measure only 96 in. across, about half the measurement of many older types.

Subassemblies are arranged top to bottom as follows: power switch and fuse panel, left feed reel panel, right feed reel panel, dual film-drive mechanism, switch panel, torque-motor trip-switch panel, left take-up reel panel, right take-up reel panel and amplifier shelf assembly.

Master input control of the single-phase a-c power supply for the torque motors used to drive the reel spindles is provided by the switch and fuse panel. This panel contains master switch, line fuses and a pilot lamp. A removable door permits front-panel access to the fuses and pilot lamp.

Each reel panel assembly consists of a single-phase torque motor, a reel shaft ball-bearing mounted in a supporting housing, a three-to-one pulley and belt drive between motor and reel shaft, and a panel for mounting the components. The three-to-one belt drive permits the use of a smaller and less expensive torque motor than would be necessary if the torque motor were directly coupled to the reel shaft. The belt drive itself is composed of standard V-belt pulleys and V-belt.

Dual Film-Drive Mechanism

The dual film-drive mechanism is situated immediately behind its associated motor-drive panel. Design details of this mechanism are shown in Fig. 1. Instead of a basic front-panel structural member onto which the various components are mounted in a more or less cantilever fashion, the structural support for the primary rotational elements consists of two spaced and match-bored

plates combined into a rigidly aligned mounting structure by means of through-bolts and spacers. Sprocket shafts, drum shafts and tension roller-arm pivot shafts extend through both the front and rear panels, and are mounted on precision-grade ball bearings. Tension roller arms and flywheels are mounted on their respective shafts in the space between the two panels to provide more uniform bearing loading and protection from accidental damage to the shafts by holding to a minimum the shaft extension in front of or to the rear of the mounting structure. On the rearward extension of the tension roller-arm pivot shafts are mounted collars into which are inserted radially extending rods for attaching the ten-

sioning springs and piston rod of the adjustable air-type dashpot.

A separate interlock motor with integral gear reducer is used for driving each of the two sprocket shafts. Driving torque of each motor is transmitted to its adjacent sprocket shaft through a flexible coupling. Motors are adjustably mounted and aligned with their driven sprocket shafts. The motors are mounted on a common panel which is supported by brackets attached to the rack frame.

Cylindrical-Type Magnetic Head

Design of the magnetic heads is shown in Fig. 2. The overall head assembly consists of a cylindrical head mount having two radially bored cavities of equal size for 35mm-type (single cavity for 16mm and 17½mm) and an annular recess adjacent to the mounting end, a 200-mil-wide magnetic head whose core structure is assembled in a cylindrically shaped housing, a hum-bucking ring, a cylindrically shaped film supporting

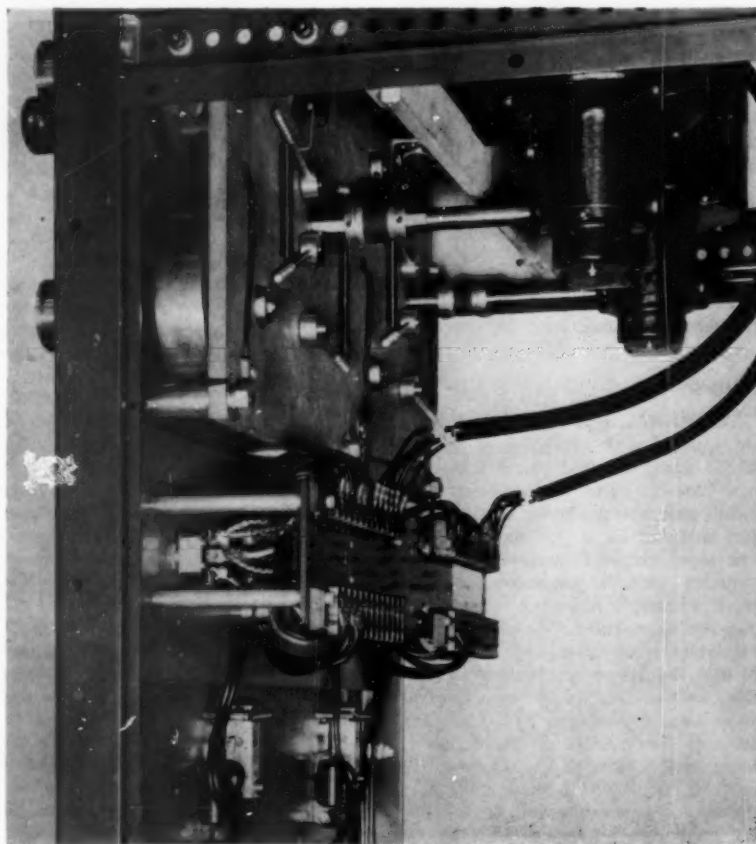


Fig. 1. Rear view of dual film-drive mechanism.

Presented on May 6, 1959, at the Society's Convention at Miami Beach by John V. Leahy for the author, Carl E. Hittle, Radio Corp. of America, 1560 N. Vine St., Hollywood 28. (This paper was received on August 31, 1959.)

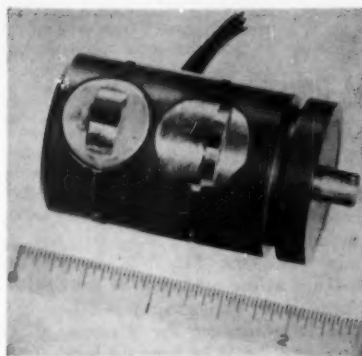


Fig. 2. Cylindrical-type magnetic-head assembly for 35mm film.

shoe (for 35mm) having the same radius as the magnetic head in the gap region, and two mounting clamps used for mounting the head housing to the film-drive mechanism panel.

For the 35mm film version the head-mount construction permits assembly of the head and shoe in either the Number 1 or Number 3 track position. Provision is made for making azimuth adjustment of the head while reproducing azimuth film. This is accomplished by loosening a head clamping set screw, rotating the head slightly by means of a wrench applied on the rear extension of the head housing, and then retightening the set screw. Adjustment of the head for correct rotation at the gap is made by loosening the head-mount clamp screws, rotating the entire head-mount assembly until the gap is centered in the area of film contact, and then retightening the clamp screws.

A hum-bucking ring adjustably mounted around the head housing obviates enclosing the head in a separate shield box or using an expensive fabricated head shielding.

When the magnetic head requires replacing, only the head needs to be replaced. The associated film-supporting shoe may be rotated to an unworn section, thus making it usable through the life of at least six heads.

Motor Control Panel

Interlock motor-bus disconnect switches and torque-motor function-selector switches are group-mounted on the motor control panel. Two switches on each side with the common operating bar are for stator and rotor of the sprocket-shaft-drive motor. The stator switch has a fourth pole which is used for simultaneous power switching to the lower torque

motor for normal operation. Circuit to the torque motors must be completed through a second switch mounted on the torque trip-switch panel. The third switch in each group is used only for energizing either the upper or lower torque motor for rewinding up or down.

The film paths (Fig. 3) as determined by the rollers and reel shafts are arranged so as to clear the areas of the motor control switches.

Terminal boards for all interconnecting motor power and control wiring are located on a common panel mounted by means of spacers and through bolts from the rear side of the switch mounting panel. Arc suppressors for the switches, commonly referred to as "depoppers," are also mounted on this assembly. Concentration of power wiring greatly simplifies the wiring required after assembly of the various panels that constitute the overall film drive.

Torque-Motor Trip-Switch Panel

Means for automatically turning off the power to the torque motor which is being used for take-up operation is provided by an assembly consisting of a mounting panel, and, for each film system, a set of components consisting of a fixed-position flanged roller with a centrally located relief, a cylindrically shaped Teflon shoe mounted on a sprung arm, and a microswitch which is used in the torque-motor circuit.

With no film between the roller and shoe, a pin adjustably mounted to the sprung shoe arm is held engaged with the microswitch, thus opening the circuit to the torque motor. With film between the roller and shoe, the actuating pin no longer engages the microswitch and thus permits the torque-motor circuit to be completed through the microswitch. When the film has run out between roller and shoe, the circuit to the torque motor driving the take-up reel is opened.

Magnetic Playback Amplifier

Amplifiers for each of the two reproducing channels are mounted on a standard rack-type amplifier shelf which is installed at the bottom of the rack. Amplifiers in current use are of the conventional vacuum-tube type.

Amplifiers are equalized to give a flat output response from a magnetic film recorded under standard conditions. They have sufficient gain for direct monitoring with headphones, and may also be used to drive a suitable power amplifier with its associated monitor

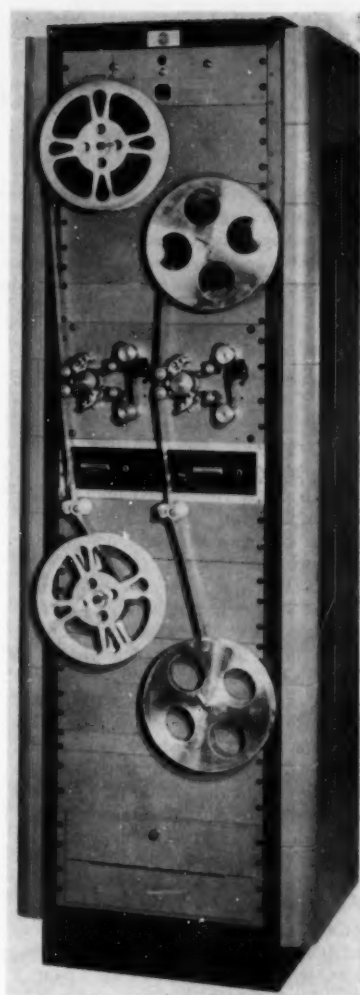


Fig. 3. Front view of magnetic dual-dubbing reproducer.

speaker. A continuously variable-gain control is also provided.

An output level of 10 dbm is obtained when a 100% modulated magnetic track is reproduced by a magnetic head (10-dbm level is for 100% modulated film at 1% distortion; a 14-dbm level can be had from 100% modulated film at 2½% distortion).

Amplifier power requirements are 10 ma at 250-v d-c and 525 ma at 12.6-v d-c for each amplifier.

The equipment is not limited to the use of the same width of film on the two sides. If desired, a unit may be obtained which can accommodate film of different width on each side, for transfer work.

New, Compact Light Sources for High-Speed Photography

By WILLETT R. WILSON

Small and especially compact incandescent light sources are frequently needed when recording high-speed phenomena in crowded spaces. Self-contained reflector lamps have been designed considerably smaller than previous types and with an improved beam pattern. They require no auxiliary equipment and types are available for use on aircraft voltages.

THE USE of ultra-high-speed photography in photographic instrumentation and in the analysis of machine functions and mechanical operations in industry has increased fantastically during the past ten years. High-speed photography is becoming an almost indispensable tool for the equipment designer and the machine maintenance engineer. The action of machine parts and the development of stresses and strains are revealed by high-speed photographic cameras which are therefore being made in smaller and more easily portable sizes to permit their increased use at the actual scene of the work to be studied. In the cramped spaces in which the camera frequently must be operated, large-size conventional light sources present an added problem to the photographer.

Engineering and analytical photography require pictures having a maximum depth of focus. Obviously, in order to obtain the depth required, camera lenses should be stopped down as far as possible. At higher picture-taking rates, where the exposures vary from 1 to 200 μ sec, and with only commercially available films for exposure, a possible solution was the development of tungsten light sources of high intensity.

Early Types of Lamps

As far back as 1932, when rotating-prism cameras became available and were applied primarily in the laboratory, tungsten lamps were used in spherical and ellipsoidal focusing reflectors. Several types of lamps were used: projection lamps with coiled coil or biplane filament structures; lamps up to 2000 w in sun-spots, in which the lamp socket was reversed in position so that the filament could be imaged on the subject at near distances (4-8 ft); and other types, including 250-w and 750-w projection lamps in smaller reflectors, for very near distances (1-3 ft). The filament position could be varied by sliding or racking adjustments, so that the filament image would illuminate the subject.

Presented on May 4, 1959, at the Society's Convention at Miami Beach by Willett R. Wilson, Lamp Div., Westinghouse Electric Corp., Bloomfield, N.J.
(This paper was received on July 15, 1959.)

In all cases, however, the lamps were used at a higher voltage than they were normally rated. At its melting point of about 3700 K, tungsten will give a theoretical output of 52 lm/w, but no lamp has yet been designed to work under these conditions. The principle of the photoflood lamp is based on roughly doubling the applied voltage to the rated filament voltage. It is found that by doubling the voltage, the lumen output is increased by as much as 10.4 times. The constant is based on gas-filled tubes. When lumens per watt is substituted for volts, the constant becomes 1.84.

It was always necessary, for best results, to use the lamps in pairs so as to be able (1) to run them off a series-parallel switch — series for focusing and parallel for exposure. (The filaments could have a tendency to arc with the sudden inrush of current at cold-filament low resistance.); and (2) to superimpose the lighted areas to overcome any dark spots in a single lamp pattern.

Where portability or limited space requirements were involved, the next step was to apply the show-window type of spotlight or airplane landing lamps. The show-window spotlight lamps were preheated at 115 v (normal voltage) and then switched to 208 v for exposure. Lamps with thick glass bulbs were employed for this purpose. For aircraft, the landing lamps were used, four in series for focusing, and then one lamp was cut out for exposure, leaving three in series. Twenty-four volt lamps were used on 28-v circuits. The filament patterns were not very good with the landing lamps. Special mounting racks had to be designed for the lamps since they are not furnished with ordinary sockets.

During World War II, at the suggestion of the Army Air Force at Wright Field, the RSP2 lamp, a 500-w reflector spotlight, was developed. This lamp has a medium screw base, which means easy adaptability. The end of the RSP2 bulb, however, is lightly frosted, which causes some light dispersion and a consequent lower light output for smaller areas. Because of the diffused

light, it is not nearly as efficient as the more cumbersome reflector sources used earlier.

In 1943, the PH/750R lamp was designed at the suggestion of the SMPE High-Speed Photography Committee. This lamp images the filament at a distance of 14-18 in. from the lamp. The 750R lamp was used in pairs and almost equaled the light output of the 750-w 100-v projection lamps operated at 120 v.

All of the above lighting systems were adequate for taking pictures at 10,000 frames/sec at $f/8$ on a film which had an ASA tungsten rating of 125.

One serious disadvantage of lamps of this type was the current drain. If four of these 750R lamps were turned on full brightness and the high-speed camera started, the lamps would dim and the camera acceleration would be degraded because of voltage drop, if both lights and camera were on the same circuit. Split circuits were found to be advisable.

Development of Smaller Lamps

In 1956, an engineering program was started for the purpose of developing a lamp which would have about the same light output as the 750-w R40 high-speed lamp, but which would require less current. Two basic voltages were to be established, 120 v for normal usage and 28 v for aircraft and portable use. The smaller in size that the lamp could be, the better.

The first samples of a 300-w R30 bulb lamp showed excellent promise. The efficiency of the lamp was increased by replacing the inside ceramic disk with a more spherical disk which was reflective. This improved the projected light pattern considerably by making it more uniform in brightness. These new reflector lamps are designed to work at their best at a distance of 10-14 in.

The essential technical data for the two new lamps, which are designated as the DVP and DXA, are given in Table I. The first lamps off the production line were rated at 120 v. The light output measured at 12 in. from the end of the bulb is greater than 33,000 ft-c, which is comparable to that of the 750-w R40 bulb. The lamps should be operated from a series-parallel circuit, as were the other previously mentioned lamps.

The aircraft-voltage DXA lamps (28 v) are now also in production. The light output is somewhat greater than that of the 120-v lamp, being 38,000

Table I. Data on DVP and DXA Lamps for High-Speed Photography.

Lamp designation	DVP	DXA
Service.....	High-speed photography	High-speed photography
Watts.....	300	300
Volts.....	115-120	28
Average life, hr.....	4	4
Bulb.....	R30	R30
Base.....	Medium screw	Medium screw
Filament construction...	CC-2V	CC-6
Max. overall length, in..	5 $\frac{3}{16}$	5 $\frac{3}{16}$
Standard package quantity...	24	24
List price....	\$3.15	\$3.30

ft-c. Both the DVP and the DXA 300-w R30-bulb lamps are supplied with medium screw bases, and some thought is being given to the desirability of furnishing these lamps in a medium prefocus type of base to prevent the possibility of the lamps shaking loose when mounted on a machine where there is excessive vibration.

Table II presents approximate exposures for four different, 16mm films at 500-10,000 pictures/sec, using four R30 lamps, 12 in. from the subject and superimposed.

Table II. Approximate Exposures for Four 16mm Films at Various Picture-Taking Rates Using Four 300-w R30 Lamps, 12 in. From Subject and Superimposed.

Pictures No./sec	16mm Films			
	No. 931	Tri-X	Koda-chrome*	Anso-chrome*
500	f/22	f/32	f/5.6	f/8
1,000	f/16	f/22	f/4.0	f/5.6
2,000	f/11	f/16	f/2.8	f/4
5,000	f/8	f/11	f/2.0	f/2.8
10,000	f/5.6	f/8	f/1.5	f/2.0

* Daylight type.

Porcelain sockets are recommended for all lamps of this type. The lamps should be burned intermittently, not to exceed 30 sec per lighted cycle. They should never be left on at full voltage for any protracted period of time. The smaller size of these new light sources and the excellent light-beam pattern make it possible to focus them on very small areas. The current drain for lamp DVP (120 v) is 2.5 amp. That of lamp DXA (28 v) is 10.75 amp and the PH/750R lamp draws 6.6 amp.

A 30-amp feeder line was required for four 750R lamps, but the normal 15-amp line is suitable for the DVP lamp, which is rated for 120-v operation.

At equal distances from the light source and when the light output is measured with a foot-candle meter, the DVP lamp is 30 times as bright as the RFL-2 500-w, reflector photoflood lamp.

For best results with these new smaller lamps, they should be clustered as closely as possible to the optical axis of the camera lens. Less exposure is required if the angle of incidence of the light is as close as possible to zero degrees. Certain medical subjects, such as the eardrums and vocal cords (both of these being cavity pictures), require only a single lamp for picture-taking rates of 5000 frames/sec when the light beam is on the optical axis.

Temperature Problems

Radiated heat from high-intensity light sources has always been a problem. With a photoflood lamp, the relative energy for various light bands is as given in Table III. The 750-w R40 and the new compact 300-w R30 lamp will peak slightly below 8500 Å because of the shift toward blue with the increase of color temperature. The intensity, however, is higher, since the photoflood lamp is burning at 3400 K and the high-speed photographic lamps burn at about 3510 K.

A number of different methods have been used to bring the temperature of the beam to approximately ambient room temperature. The most common method employs water cells. These have been constructed in a number of ways; the basic one has a metallic ring with glass ends, rubber "O" rings which act as ceiling gaskets and a means of clamping the assembly together. The metallic ring has two holes approximately $\frac{1}{4}$ in. in diameter drilled in it, close together. One hole is used for filling the cell with water while the other acts as an air vent for filling or emptying the cell. A water cell should never be filled completely, since the water will expand when heated by the absorbed infrared energy. There is only a little loss in light with a cell 1 in. thick.

Kolle culture flasks also make excellent water cells, since the only problem connected with them is mounting them in front of the lamp. They come in various sizes and can be secured from chemical supply houses. The Kolle cell is advantageous when a cupric solution for absorbing the heat is used, since there is no problem with corrosion, which occurs when metallic ring cells are used.

Dilute solutions of cupric chloride and cupric sulfate have been used as heat-absorbing solutions. These solutions are more efficient than water, but there is greater loss in transmitted light and, if color film is being used, the reds are badly distorted.

Heat-absorbing glass such as Aklo can be used. Aklo glass does have one disadvantage — with the concentrated beams, the glass may break because of its low thermal conductivity due to its annealing and hardness.

Table III. Relative Energy for Various Light Bands, Using a Photoflood Lamp.

Angstrom units	Relative energy
3,500	8
4,000	15
5,000	48
6,000	73
7,000	92
8,500	100
10,000	92
15,000	55
20,000	30
30,000	17

Recently there has been an announcement of mirror coating materials that transmit the infrared and reflect the visible light. These mirror materials are of great value in the mirror-reflector type of illumination where the mirror images the filament at the subject plane. The primary use of these mirrors is for arc-type motion-picture projectors to reduce the heat at the film plane. Such mirrors are dichroic, transmitting one band of light and reflecting another.

The heat dissipation is necessary when working with living tissue, plastics and many other materials, particularly dark-colored ones. The performance of many subjects under study will be affected by their temperature.

A piece of black paper can be set on fire from the projected filament image, but if a heat-absorbing filter is interposed, the back of the hand can be placed at the focus of the lamp and there will be no discomfort. In fact, the back-of-the-hand test is a very useful check for the heat factor.

Illumination Control

The distribution of the light beam is an important factor in evaluating light sources for ultra-high-speed photography. The usual procedure is to plot the distribution on a polar coordinate scale. An alternate method is to plot angle from lamp axis in degrees against candlepower on linear coordinate paper. The angle of maximum candlepower rating will be the most practical to apply for high-speed motion-picture photography.

In making high-speed motion pictures, the light-control switch for full brightness is in many instances thrown at the same time as the camera-control switch. The higher the wattage of the lamp, the longer the time to reach full operating brightness. With a 300-w lamp, the lamp will be at 90% brightness in 0.27 sec, while a 1000-w lamp takes 0.67 sec to reach the 90% figure. Additional time must be allowed to reach 100% brightness. Where the light-control switch is thrown on the same control as the camera, the automatic timer should be set to operate 2 sec before the camera operates. Failure to consider this slight time-delay factor has resulted in the

Table IV. Resistivity of Tungsten at Various Temperatures.

Degrees Kelvin	Resistivity, ohms/cm ²
293	5.51
1000	25.3
1500	41.4
2000	59.4
3000	98.9
3510	118.0

failure of many time-lapse camera applications.

Relation of Resistance and Current to Temperature

The use of series-parallel switches has been discussed and it was pointed out that preheating the filaments when using them in series was advantageous. Table IV gives the resistivity of tungsten in ohms centimeters at various temperatures.

As shown in Table V, the operational resistance (at 3510 K) of the 300-w R30 120-v DVP lamp is 48 ohms; that of the 300-w R30 28-v DXA lamp, 2.6 ohms; and that of the 750-w R40 lamp is 19.2 ohms. The room-temperature ambient (293 K) resistance is 4.7% of the operating temperature (3510 K) resistance; while that at the 2000 K point, which is about the temperature of the series operating condition, is 50.3% of the operating resistance.

The currents involved at the same ranges of temperature are given in Table VI.

Lead-Wire Size and Length

These resistance and current values have to be correlated with the size and length of the lead wires from the power source to the lamps themselves. For correct operation the lead wires should be designed to give a minimum drop in potential. In connection with the data given in Table VII, it should be assumed that the line length is 20 ft and that the four lamps will be on a single circuit.

For normal operating voltages, the wire sizes should be those given in Table VIII. If, however, four DXA 28-v lamps are burned in series at 115

Table V. Resistances for Lamp Operation in Relation to Temperature.

Lamp at	Resistance, ohms		
	293K	2000K	3510K
DVP (120-v)	2.256	24.144	48
DXA (28-v)	0.1222	1.3078	2.6
PH/750R	0.9024	9.6576	19.2
1000-w (100-v lamp at 120 v)	0.5123	5.777	10.9

Table VI. Current Required for Lamp Operation in Relation to Temperature.

Lamp at	Current, amp.		
	293K	2000K	3510K
DVP (120-v)	53.19	4.959	2.5
DXA (28-v)	232.95	21.41	10.75
PH/750R	132.83	12.42	6.6
1000-w (100-v lamp at 120 v)	234.13	20.77	12.0

v, the values for the 1000-w lamp can be used, since a little over 10 amp will be required, which of course is the same as for the 300-w lamps burned in parallel.

When using series-parallel switches, the rating for the contacts must also be considered.

There are many light sources that are useful for high-speed photography motion pictures. It is hoped that the introduction of these new, smaller and more compact light sources will contribute toward the increased use of high-speed photography in science, in industry and in military applications.

The author is greatly indebted to John H. Waddell, consultant on high-speed photography, for his valuable contributions to this paper.

Table VII. Relation of Current and Resistance to Wire Size.

Wire size (flex. cable)	Current-carrying capacity (4 lamps), amp	Line resistance, 20 ft (2-conductor), ohm
18	5	0.256
16	7	0.1606
14	15	0.1010
12	20	0.0636
10	25	0.040
8	35	0.052
6	50	0.0158
4	70	0.0099
2	90	0.0062

Discussion

Fred Swartz (NASA Ames Research Center): Are you doing work on improved sources for broader coverage at the greater distances? There is a need for such sources.

Mr. Wilson: Our intention, of course, in designing these lamps has been just the opposite of what you mention. They are designed to cover small areas in hard-to-get-at places; and though we are thinking along the line of broader coverage we have nothing to report now.

Anon.: Has there been any type of unit developed for using these lamps in a hazardous location where there may be explosive materials, gases, etc.?

Mr. Wilson: I don't know of specific units, but the same precautions should be taken with these lamps, as with any other incandescent tungsten source. There are explosion-proof fixtures for Hi-Speed lamps. There is likely to be some reduction in light output due to the thick glass used in explosion-proof units.

John E. Volkmann (Radio Corp. of America) Has the polar distribution characteristics of these lamps been measured? What is your estimate of the coverage angle in degrees?

Mr. Wilson: A design criterion was to illuminate an area about 2 in. square, from a distance of 12 to 24 in. At 18 in. distance the standard voltage lamp #DVP has a total effective spread of approximately 16°; the 28-volt #DXA, about 8°.

Table VIII. Wire Sizes for Lamps Operated at Normal Voltages.

Lamp	Current, 1 lamp		Current, 4 lamps	
	Normal	Allowance for start	Normal	Allowance for start (2000K)
DVP (120-v)	18	18	14	12
DXA (28-v)	14	10	6	2
PH/750R	16	16	10	6
1000-w (100-v at 120 v)	14	12	6	2

A Flood Flashlamp for High-Speed Motion-Picture Photography

By W. C. FINK

A new light source for high-speed motion-picture photography is a flood flashlamp which contains magnesium foil and has the size and ease of handling of a #3 photoflash bulb. Exposure guide numbers for camera speeds of 400 to 8000 frames/sec and practical examples of photographic procedures are given.

THE HIGH-SPEED motion-picture camera is almost a standard tool for mechanical engineers or research workers studying interactions of rapidly moving machine parts or of fast occurring events. Methods for the evaluation of such studies are described in the literature.^{1,2,3}

The illumination for high-speed photography, however, considering exposure times of 1/1000 to 1/40,000 sec at the most frequently used camera speeds of 400 to 8,000 frames/sec, requires special equipment.

The light sources used at present consume 2 to 10 kw, such as six or more reflector flood lamps, 115-v PAR-type lamps burned at 190 v, or electronic flashlamps filled with xenon gas. These lamps are operated by an external power supply or heavy storage batteries. Twenty aluminum-filled focal-plane flashlamps mounted in a special reflector are also used and give a total duration of about 1 sec. The handling of such light sources is time consuming. The weight and bulkiness of the equipment makes moving costly. Heavy electrical lines and power consumption frequently interrupt electrical circuits and machine operation. More recently developed high-speed motion-picture cameras are portable, and have battery-driven motors which are independent of an external power source.

The development of a self-contained light source was undertaken to fill the need for a less time consuming, and therefore more economical technique of high-speed motion-picture photography.

The photographic flashlamp was chosen as a possible approach for the solution of the problem. The lamp is self-contained, can be started with a low-electrical energy at 4.5 v and can be easily handled. The energy for the light emission is produced by the burning of a metal in an oxygen atmosphere. The amount of the available oxygen, given by the volume of the glass vessel and the gas pressure will determine the quantity of metal burned. The caloric output of the burning process must be transformed into

the optimum light-time relation suitable for high-speed motion-picture photography. For practical purposes this is a duration of about 2 sec with a light level of 50,000 to 100,000 lm for an illuminated area of 1 to 2 sq ft.

Three metals, aluminum, zirconium and magnesium, were considered as combustibles. Aluminum in foil form is not easily combustible and in the form of filament it burns too fast. The use of zirconium in the manufacture of flashlamps is a comparatively recent development. The zirconium-filled miniature flashlamp has a light output of 2100 lm/sec/ml vessel volume, which is twice as high as the 1000 lm/sec for aluminum flashlamps. Zirconium will readily ignite but will not maintain a high level of light when burned in the form of a foil. Magnesium foil ignites as easily as zirconium foil and burns with a much higher light output. The magnesium metal is transferred from the solid form into the vapor state by the heat of the reaction. The melting point of magnesium is 651 C, and the boiling point only 1107 C, a difference of 456 C. These are low temperatures when compared with the melting point of zirconium at 1900 C and its boiling point of 2900 C. The heat losses at the high boiling point of zirconium are such that an insufficient light output results from the slow reaction. The combustion of magnesium has a color temperature of 3800 K, and is difficult to contain in a glass vessel when pure oxygen is used for the reaction. A small amount of N₂ was therefore mixed with the oxygen, modifying the speed and pressure development of the magnesium burning and creating optimum conditions for the light level and the duration of light emission.⁴

Final Design

The lamp as finally designed is shown in Fig. 1. The magnesium foil is suspended in a glass envelope and has a narrow strip of ignition paste at its lower end. The ignition of the lamp is accomplished by setting off the two ignition beads at the ends of the lead wires below the magnesium foil, which in turn ignite the paste on the foil and the foil itself.

The plateau light level of the FF-33

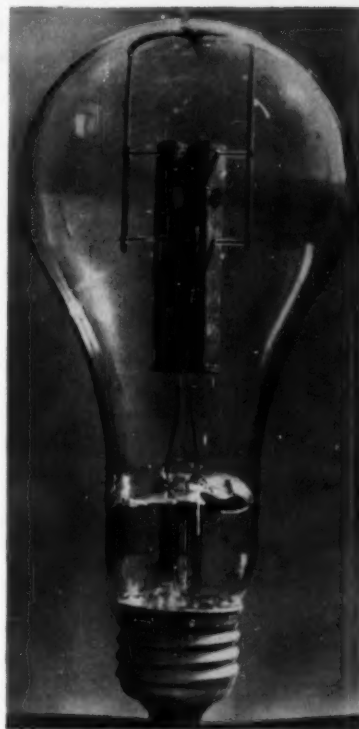


Fig. 1. FF-33 flood flashlamp.

lamp averages 75,000 lm over a time interval of 1.75 sec. An illumination of 200,000 ft-c can be achieved in a 7-in., highly polished reflector when the lamp is flashed with the base down at a 12-in. light-to-object distance. A time-light diagram (Fig. 2) illustrates the reasonably uniform light level for the 1.75-sec duration. The lamp reaches the plateau level within 50 msec. It has the same size as a #3 photoflash lamp (Fig. 3), and can be flashed with 4.5 v from three D-cells. The usable light duration of 1.75 sec is thirty times longer than that of a #2A focal plane flashlamp. The total light output of 150,000 lm/sec is 50% higher than that of a #3 lamp. This lamp has all the conveniences of a photographic flashlamp. Guide numbers have been calculated for various film speeds (Tables I and II), making it easier to find correct aperture settings. Camera speeds of 400 to 8,000 frames/sec, the most practical speeds for FF-33 lamps, are tabulated. The guide number table eliminates the need for a light meter, specially adapted for high-illumination levels. The film length exposed by one lamp is 37 ft for 1000 frames/sec and 75 ft for 2000

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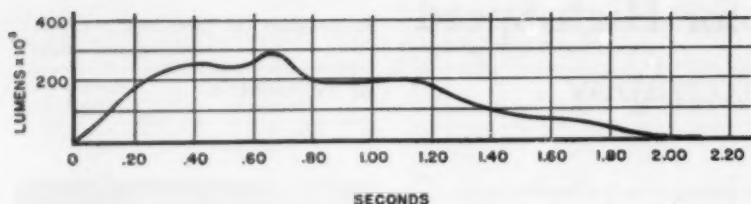


Fig. 2. Time-light comparison of FF-33 lamp: usable duration 1.75 sec; average light level 75,000 lm reached in 50 msec.

Table I. Guide Numbers for Floodflash Lamps.*

Av. Camera Speed, frames/sec	Frame Exp., time, sec	FF-33 Lamp Guide Number for Light to Subject Distance in Inches				
		$\frac{1}{2} \times \text{recipr. ft/sec}$	25-50	50-100	150-200	250-300
400	5.0×10^{-4}	72	96	156	204	
600	3.3×10^{-4}	60	84	120	168	
800	2.5×10^{-4}	48	72	108	144	
1000	2.0×10^{-4}	46	64	97	127	
1500	1.5×10^{-4}	38	55	84	110	
2000	1.0×10^{-4}	32	45	68	90	
3000	6.6×10^{-5}	26	36	56	76	
4000	5.0×10^{-5}	23	32	49	61	
5000	4.0×10^{-5}	20	28	43	54	
6000	3.3×10^{-5}	18	26	39	50	
7000	2.8×10^{-5}	17	24	36	46	
8000	2.5×10^{-5}	16	23	34	43	

* The first column gives the average camera speeds. The next column gives the exposure times figured as $\frac{1}{f} \times \text{reciprocal frames/sec}$. A smaller aperture opening of one-half *f*-stop should be used with cameras calculating the exposure time as $\frac{1}{f} \times \text{reciprocal frames/sec}$. The guide number has to be divided by distance of lamp to subject in inches, to find the *f*-stop.

Table II. Film Rating in ASA Exposure Index.

16mm Film Types	Tungsten
DuPont 928A Superior #4	250
Super Anscochrome Tungsten	100*
Eastman Tri-X Reversal Type 7278	160
Eastman Plus-X Reversal Type 7276	40
Fastax 931, Wollensak	125
Superior #4 Negative, Wollensak	250

* 81D Filter, exposure increased one stop.

frames/sec. Several lamps must be flashed in sequence of 1.75 sec at slower camera speeds, as indicated in Table III.

Simple timing switches, operated by cams driven by a 6-v d-c motor, can be bought commercially* and are comparatively inexpensive. Figure 4 shows such a timer closing seven circuits in intervals of 1.75 sec. Its wiring diagram is shown in Fig. 5.

The following examples will illustrate the procedure for taking pictures with flood flashlamps. Eastman Tri-X Reversal Type 7278 16mm film was used and developed for 5 minutes at 68 F in D-19 developer to the negative stage only. The light-to-object distance was kept at 18 in. The lamps were flashed with the base down in a 7-in. reflector

* The d-c motor and switches were supplied by W. C. Cramer Co., Centerbrook, Conn.

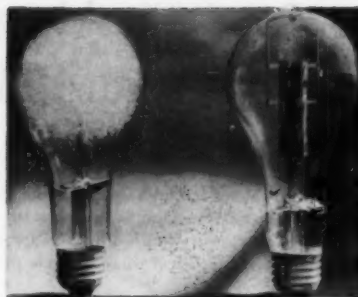


Fig. 3. Comparison of dimensions of a #3 photographic flashlamp with those of floodflash lamp F-33.

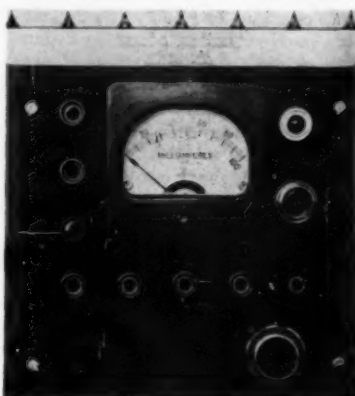


Fig. 4. Timer for flashing floodflash lamp in sequence of 1.75 sec.

at 4.5 v from D-cells. The photography was accomplished, as shown in Table IV, at three camera speeds, to produce negatives easily printed into fine-grain positives.

A rotating color disk photographed at 800 frames/sec at an aperture of *f*/4 gave excellent color reproductions on Tungsten Super Anscochrome with an 81D

Table III. Number of Lamps Required at Various Camera Speeds.

Frames/sec	Exposed Film	
	75 Ft	40 Ft
400	4	3
500	4	2
600	3	2
700	3	2
800	2	2
900	2	1
1000	2	1
1500	1	1
2000	1	1

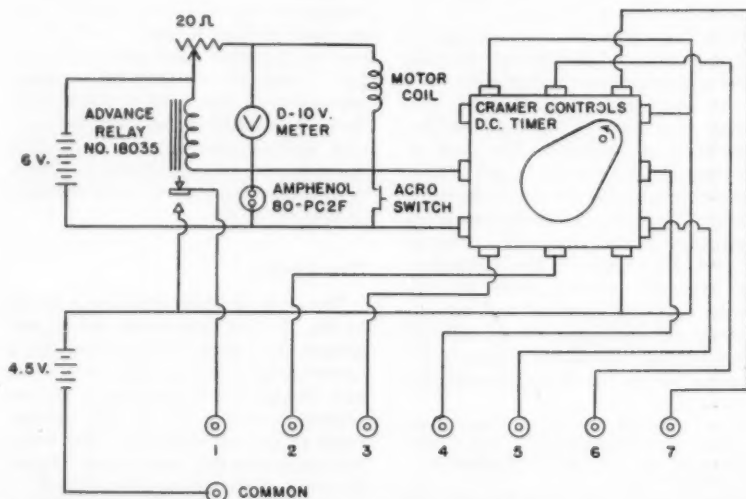


Fig. 5. Wiring diagram of sequence timer for seven FF-33 lamps.

Table IV. Photography at Three Camera Speeds.

Average Speed, frames/sec.	f-Stop	ASA Film Index
300	11	160
600	8	160
2000	4	160

Wratten filter for color temperature correction.

The lamp and the technique of its use shows that as much as 75 ft of film can be exposed in a high-speed camera without the use of an external power for the light source. The FF-33 flood flashlamp facilitates the high-speed motion-picture photography to such an extent that great reductions in the cost of carrying and setting up lighting equipment can be achieved.² The correct setting of lens apertures is also reduced to finding the proper values in the guide number tables.

The author wants to express his thanks to R. G. Petts, head of the Electronic

Section of the Photoflash Division of Sylvania Lighting Products Inc., who was very helpful in having photometric equipment assembled, the sequence timer built, and photographic work done.

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Discussion

L. L. Endelman (*Convair-Astronautics*): Were the numbers you used in units of inches or feet?

Dr. Fink: It should be emphasized that the distance is to be measured in inches and the

guide number divided by the distance in inches so that you arrive to your f-stop.

Hans Hauser (*Tropical Films Inc.*): What would be the equivalent of these flashes with regular incandescent bulbs?

Dr. Fink: We figure normally anywhere from two to three reflector spots — 350-w reflector spots.

Fred Swartz (*NASA Ames Research Center*): Are these data that you presented on the screen available in printed form?

Dr. Fink: Yes, we have printed forms which give you all the details, more than I can give at this time.

Edmond L. Fisher (*Univ. of Miami Marine Laboratory*): You say that flashlamps can be used under water; do you have any figure of the depth they were used at?

Dr. Fink: No, we mentioned it only because the simplicity of flashing it under water was a rather interesting idea.

Mr. Fisher: Have you any statistics on the percentage of cracking of your bulbs and error?

Dr. Fink: No, they may crack sometimes; but it will not influence the light emission. The blue dot on the stem of the lamp indicates an unbroken envelope. The spot will turn pink from the moisture of the atmosphere penetrating a broken glass envelope, indicating that the lamp is defective. Failures for other reasons than broken glass are about one in two thousand.

A Multi-PAR Lamp Luminaire for Light Projection

By F. E. CARLSON

The properties of the sealed-beam types of tungsten-filament lamps are utilized in a luminaire, the characteristics of which include: substantially higher peak beam candlepower at narrower beam spreads than have been reported for tungsten-filament spotlights of comparable wattage; oval or approximately rectangular beam patterns of rather precise angular dimensions by the use of refractive plates on or in front of the lamps; a step type of dimming control that does not alter the color temperature of the composite beam. These features and the methods of obtaining them are discussed.

WHILE THE TERM "sealed-beam" was originally used to describe a unique type of incandescent lamp developed for automobile headlights, it is used today to describe most lamps of the same basic construction. All such lamps include an efficient and precisely-formed parabolic* glass reflector section, an accurately-positioned filament, and a hermetically-sealed glass cover that may be either clear or diffusing, or which may include refracting elements for beam modification. Thus, sealed-beam lamps may be

designed for any of a wide variety of beam patterns and, in all cases, they provide efficient control of light not only initially but throughout the life of the lamp.

It is only natural that such lamps have been considered, and are being used, for studio lighting and for many other applications where efficiently produced beams of light are needed. In fact, the extent of their use has been limited principally by the maximum amount of wattage that may be effectively used in each of the several sizes that are available. This paper describes a method that has been developed for achieving substantially greater light output and beam candlepower. The method requires the use of several sealed-beam lamps of the same type mounted closely together in a fixture and aimed so that their axes are caused to converge to a common point.

This method is practicable and is effective because of the remarkable consistency of such lamps in terms of beam pattern and beam aiming. Other advantages are also described below.

Filament Fundamentals

For most studio lighting applications the color quality of the lights must be controlled and is defined in terms of color temperature, for example, 3200 K or 3350 K. This means that the total light output per input watt for filaments of various sizes and of a particular color temperature is approximately constant. It also means that the larger-size (higher-current) filaments have a longer life than the smaller, lower-current, filament sizes (Fig. 1).

The overall physical size of the incandescent filament is also of great importance when used in combination with reflectors; the smaller the light source size, the smaller the angle that the source subtends at the reflector and, therefore, the better the control of the reflected rays. Filament length is approximately proportional to voltage and, since it is obvious that long filaments are harder to get into a small space, it therefore follows that the light from lower-voltage, more compact, sources is controlled more effectively. Source

Presented on May 6, 1959, at the Society's Convention in Miami Beach by F. E. Carlson, Large Lamp Dept., General Electric Co., Nela Park, Cleveland 12, Ohio.

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* The term "PAR," used to describe such lamps, was originally adopted to describe this "parabolic aluminized reflector." Other reflector contours and reflector finishes are, of course, feasible.

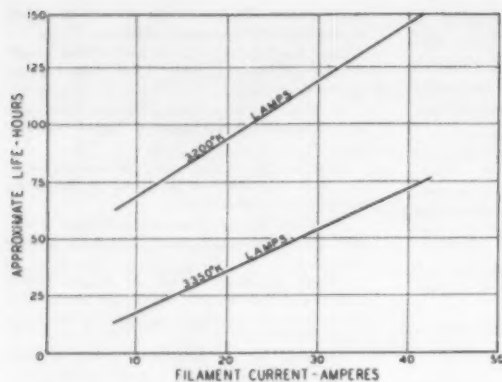


Fig. 1. While there are other factors that influence lamp performance, the life-color temperature-filament current relationship is typical for lamps of similar characteristics.

size also increases with wattage — a further argument in favor of low voltage.

From these fundamentals, it is apparent that high current (for longest life) and low voltage (for best optical control) are to be favored in any sealed-beam lamp design where efficiently produced and accurately controlled beams are required. Also, since filament brightness is a function of filament temperature, the peak beam candlepower is greater for larger reflectors and higher temperature filaments. Total light in the beam, but not peak candlepower, is proportional to filament wattage and efficiency.

Cutouts for Series Operation of Low-Voltage Lamps

Since a single sealed-beam lamp cannot provide all the light, or peak candlepower required for many applications, series operation of several low-voltage lamps in a single luminaire is a logical approach to a system of reasonable maximum current for use on standard voltage circuits. Such an arrangement, however, immediately brings to mind the inconvenience of attempting to locate a burned-out lamp in the older series-type Christmas tree strings. This difficulty can be overcome through the use of film cutouts such as have been used for many years on street lighting circuits.

There are several designs of cutouts but the type most applicable to the system described here includes an insulating film of some material such as copper oxide between two flat surfaces that serve as electrical contacts. By design, the insulating film can be made to break down in a selected voltage range so that the cutout becomes conductive. If such a cutout is connected across the terminals of each low-voltage lamp in a series group, the failure of any lamp causes the full supply voltage to be impressed across the terminals of the corresponding cutout; this then breaks down so that the remaining lamps in the series can continue to operate.

The cutouts used in the prototype luminaire described in this paper have

an approximate voltage breakdown range of 50–90 v and are capable of conducting currents of the order of 20 amp. The internal resistance of these cutouts at 20 amp after breakdown is about 0.05 or 0.06 ohms.

Circuit Design

With the lamp-cutout combinations in series, the failure of one or more lamps increases the electrical input to each of the survivors because these lamps, fewer in number, must divide the input voltage. This shortens the life of the survivors; in fact, as additional failures occur, the life of the survivors is reduced by greater and greater amounts. In some cases, and up to a certain number of failures, the increase in electrical input might be an advantage because the increasing input to the survivors increases their light output so that the total output of the fewer lamps actually exceeds that of the original series group.

Usually, however, an arrangement that either maintains approximately constant voltage per lamp or limits the increase in voltage to some more conservative value will probably be preferred. This is easily accomplished by introducing an appropriate amount of resistance in series with each cutout, as shown in Fig. 2.

The use of bridging resistors offers the further opportunity in circuit design for an unusual form of "dimming." First of all, it should be remembered that sealed-beam lamps with their axes converging to a common point are used in this luminaire. Thus the substantially identical beams of several lamps add together to form a beam of substantially the same angular dimensions but of approximately proportionally greater intensity. Conversely, turning off one or more lamps subtracts light from the beam — in other words, the beam is "dimmed" with little or no change in beam dimensions. To accomplish this "dimming" in the luminaire, single-pole, double-throw switches are provided for all lamps but one in the series circuit. One position of the switch con-

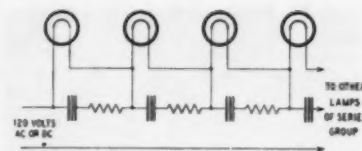


Fig. 2. Film cutouts permit the continuing operation of the remaining lamps in the series group when a lamp failure occurs

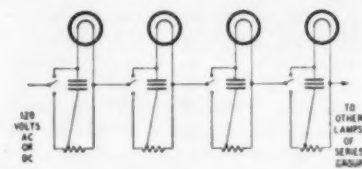


Fig. 3. The tap in the resistor adds an amount of resistance in the switch circuit that equals the average resistance of the cutout after breakdown; thus the operating current remains the same whether the lamp is operating, switched out of the circuit, or inoperative.

nects the lamp in the circuit while the other position connects the bridging resistor. This circuit, complete with the cutouts to insure continuing operation of the system, is shown in Fig. 3.

It is, of course, apparent that a relay of appropriate design can be provided to replace each switch and cutout. In fact relays have two important advantages: greater current-carrying capacity (up to 60 amp, or more), and the possibility of remote control. Disadvantages for relays include such factors as cost, size and weight, and noise.

Luminaire Design

Answers to questions regarding the number and size of sealed-beam lamps, their electrical rating, etc., depend principally upon the intended use. For example, in the case of this particular model, the decision to use film cutouts and the desire to work at the highest practicable current for such cutouts determined the current rating — 20 lamp.

The desire to "dim" the system by fairly small increments and the quest for high beam candlepower argued in favor of the maximum number of lamps in the series group. On the other hand, more than about 20 lamps on a 120-v circuit results in so low a lamp voltage that a large percentage of the filament length is subjected to the cooling effect of the large lead wires required to conduct 20 amp. The best compromise seemed to be to use 19 lamps because this number can be symmetrically disposed (Fig. 4). The lamps were, therefore, designed for 6.32 v and consume an average of 126.5 w.

This wattage is in excess of the watts used in the smallest size (PAR-36) of



Fig. 4. The 19-lamp arrangement is one that has the symmetry required to get the several beams to converge properly.

sealed-beam lamp which is of approximately $4\frac{1}{2}$ -in. diameter. Furthermore, a larger size is preferred to get greater peak beam candlepowers. For these reasons the PAR-46 size, which is approximately $5\frac{3}{4}$ in. in diameter, was selected. The combination of nineteen lamps results in a luminaire (Fig. 4) measuring approximately 27 in. wide, 30 in. high, and 17 in. deep and weighing only 68 lb.

Luminaire Performance

Developmental samples of a PAR-46 lamp having the electrical characteristics just described were constructed using a single coiled filament segment having its axis on the reflector axis. These samples produce a nearly symmetrical beam having a width that averages approximately 4° to 50% of peak candlepower; the width is approximately 8° to 10% of peak. At 3200 K, the peak candlepower averages close to 250,000; at 3350 K this value would be increased by approximately 45% .

The first photometric test with approximately parallel beams for the complete 19-lamp luminaire was somewhat disappointing. The 3200 K peak candlepower could be 4,750,000 if all 19 beams added together perfectly. Since the measured peak was only a little over 2 million it was apparent that the additive effect of parallel beams could not be fully realized except at great distances. In order to get the beams to add more nearly perfectly at closer distances, the luminaire was modified to provide adjustable "toe-in" of the beams. A test with the beams "toed-in" to converge at 50 ft resulted in a 4,600,000 peak beam candlepower — better than

95% of the theoretical maximum. This proved so successful that a "toe-out" adjustment was also included for the purpose of approximately doubling the minimum beam spread when using lamps with clear covers. Candlepower distribution curves for several "toe-in, toe-out" adjustments are shown in Fig. 5. The isocandle distribution for the composite maximum peak candlepower beam is shown in Fig. 6.

Other Beam Patterns

Other candlepower-beam spread relationships may also be obtained either by using glass covers of various refractive designs on the sealed-beam lamps or by mounting such elements directly in front of the lamps. Figure 7 illustrates representative beam shapes that are possible by refractive means. These curves were obtained by using a single lamp in combination with refractors of various designs. Of course, any system that increases the spread of light in any direction must necessarily reduce the peak candlepower even though the total lumen output remains unchanged. With those refractors that produce beams of considerable spread, the "toe-in, toe-out" adjustment feature that changes the beam spread about 10 degrees would have much less effect or value than with clear covers.

Dimming Characteristics

It was pointed out, in connection with the circuit of Fig. 3, that "dimming" control of the luminaire's total output is accomplished by turning individual lamps on or off as required. It was also pointed out that, in most cases, this is accomplished without any change in the angular dimensions of the beam. Since

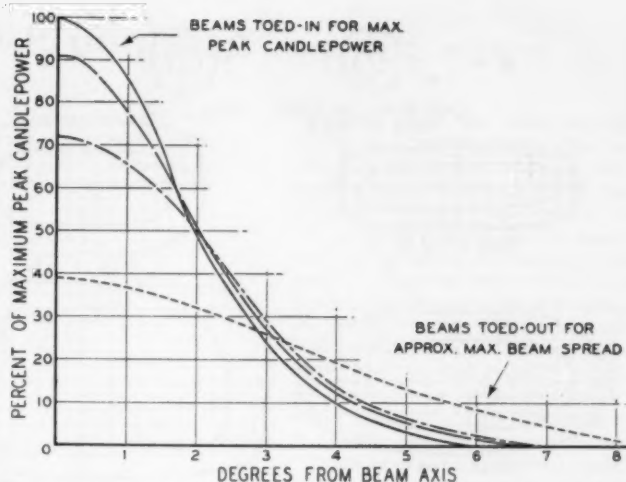


Fig. 5. Because of the symmetrical arrangement of the lamps it has proved feasible to provide at least a limited degree of beam control when using lamps producing a round spot of minimum spread.

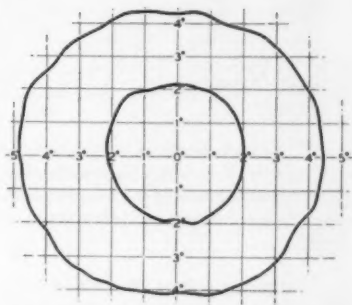


Fig. 6. In all isocandle distributions shown with this paper, the inner curve is the outer angular boundary of the area in which candlepowers equal or exceed 50% of the peak value; the outer curve defines the boundary for values at or above 10% of peak.

19 lamps are used in the prototype, "dimming" is accomplished in 19 approximately equal steps or increments that average a little more than 5% of the maximum output of the luminaire.

Of particular interest is the fact that, when the value of the bridging resistors is chosen to equal the average resistance of the lamps, each such step in dimming is accomplished without any change in the color temperature of the light.

Conclusions

In a system of this type, the peak candlepower is proportional to the brightness of the source and the total effective area of the reflectors. Thus, higher peak candlepowers than those reported here are possible by using filaments at higher color temperatures, by using the same number of a larger size of sealed-beamed lamps, by us-

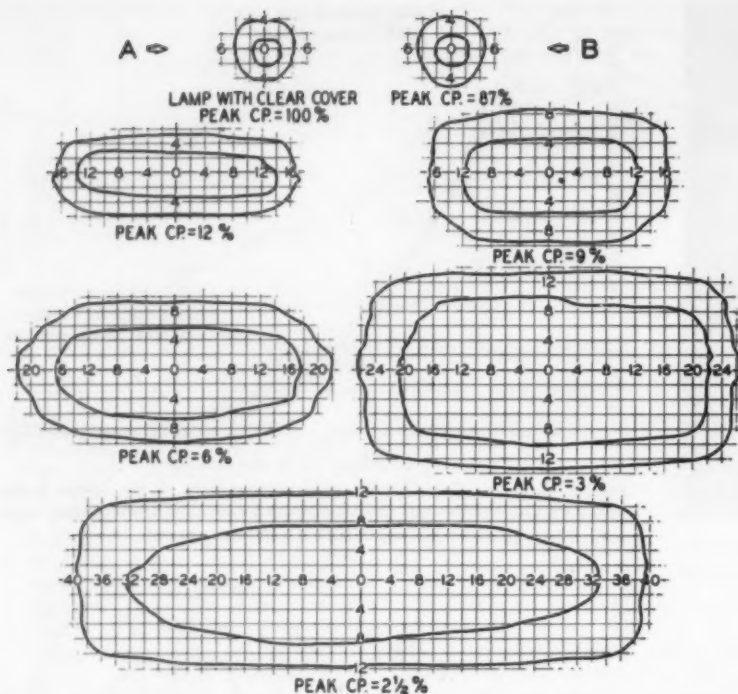


Fig. 7. The basic beam (A) of the lamp with clear cover is smoothed out and broadened only slightly (B) when a lightly stippled cover is used. Refractors make possible much greater modifications of the beam with the corresponding reductions in the peak candlepower that are shown in the few representative examples.

ing greater numbers of sealed-beam lamps, or by using any combination of these three variables. The increase in color temperature or in the number of lamps also increases beam lumens; the effect of reflector size on beam lumens depends upon whether there is a change in the collection angle of the reflector sizes.

Characteristics of multi-PAR lamp

luminaires may be summarized as follows:

- (1) Substantially higher peak beam candlepowers at narrower beam spreads than have been reported for tungsten filament spotlights of comparable wattage.
- (2) Round, oval, or approximately rectangular beam patterns of rather precise angular dimensions.

(3) A step type of dimming control that does not alter the color temperature of the composite beam, or

(4) A light projecting system, the intensity and operation of which does not immediately suffer even though a few of the individual lamps burn out.

(5) Substantial reductions in weight and depth of luminaire.

(6) The use of tungsten filament lamps of maximum ruggedness by virtue of the sealed-beam bulb construction and short, thick filaments.

Luminaires without the dimming feature could be used for many applications where beacons, searchlights, spotlights, floodlights, surgical operating lights, and similar fixtures are now used. The continued operation of the luminaire, even after the normal failure of one or more individual lamps, provides a measure of security that can be of great value. In fact, that same security of continuing operation, as well as the color temperature control and the high intensities and narrow beams, suggest the use of such a luminaire for many photographic purposes and particularly for use in motion-picture and television studios. Similarly, the oval or rectangular beams that are possible offer opportunities for very efficient, broad lighting at short distances. For such close-up use, a little of the efficiency would have to be sacrificed by the use of a front diffuser to soften the multiple-shadow effect from the individual lamps in shallow sets. The light weight of the luminaire and the great ruggedness of the low-voltage sealed-beam lamps are added advantages that could be particularly important for location use.

Thus, for large sets or small, indoors or out, multiple PAR lamp floodlights and spotlights of this type can serve as important additions to the tungsten filament lighting currently in general use.

New Horizons in Studio Production

By PAUL F. WITTLIG

New staging devices have been designed and techniques developed to overcome limitations on creative efforts, imposed by the physical boundaries of studio walls and grids. Among these, VideoScene, an electronic camera system designed to blend live action with miniature settings, is described and the new equipment and techniques are illustrated.

TO THE ENGINEER, walls are a perfectly reasonable and necessary part of any studio and lighting pipes and grids are highly utilitarian structures, but to the creative showman these are barriers, which are forever getting in the way of his creativity. The writer may not always know what can be staged within the four walls but of necessity must play it safe and be sure. He knows that unless he restricts what he writes to something that will fit into those walls, it may not fit into the producer's budget. In like manner, the producer finds himself limited in the story material he can select. He wants to move and shoot in accordance with the demands of his story, but at the same time may be faced with making the story less demanding.

While the size of studios is subject to certain economic limitations, there are techniques which create the illusion of space which are not. Since illusion is all the producer is creating anyway, these serve him well in freeing creativity from the restrictions of physical walls and grids and establishing new horizons in studio production.

The Production Development Department at CBS Television has devoted time both to the improvement of existing techniques and the development of new ones. A new one of revolutionary design called VideoScene was announced last February.

Of the existing techniques, improvements have been made in one called the Wide Angle Photomatte shown diagrammatically in Fig. 1. In the figure, it can be seen that the optical system behind the easel takes in a width of scenery about equal to its distance from the scenery. A camera in front of the easel picks up the optical image together with the photo on the easel, producing a scene five or six times the size of the portion set up in the studio. By working with larger blowups, about 3 by 4 ft, matching the blowup and live scenery is not critical. Since the easel optical system produces the image of the scenery in a focal plane which coincides with the blowup, focus presents no problem.

What is referred to as the Mill-Pond

Presented on May 6, 1959, at the Society's Convention in Miami Beach by Paul F. Wittlig, CBS Television, 485 Madison Ave., New York 22.

(This paper was received on May 18, 1959.)

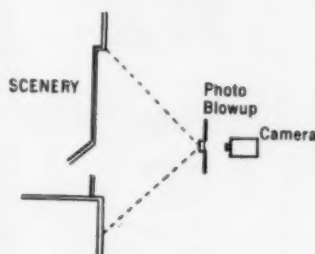


Fig. 1. Diagram of wide-angle Photomatte setup.

camera attachment (Fig. 2) is a device which positions a mirror in front of the taking lens in such manner that the top half of the scene is reflected as a mirrored image in the bottom half of the picture frame. By simulating a reflection from a still body of water, the device can be used to create the illusion of a pond without actually installing one in the studio. Not only is the cost of the pond avoided, but valuable floor area is kept clear for camera movement. The attachment is mounted on the standard CBS effects adaptor so that once the final adjustments are made in rehearsal, and locked, it can quite readily be removed and put back without further adjustment.

Mounted on a modified effects adaptor, a periscope (Fig. 3) increases the effective height of the taking lens by 46 in. and provides as high a shot with a pedestal as can be obtained with a

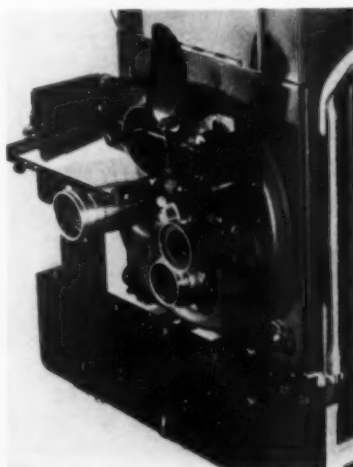


Fig. 2. "Mill-Pond" camera attachment.

television crane but with economies in both space and manpower. The objective lens mounted in the top has a focal length of 50 mm and relay lenses deliver an image to the camera tube with a speed of $f/5.6$. In the inverted position, the taking lens can be brought within a couple of inches of floor level, a point of view needed for choreography but which is often difficult to achieve without digging a hole in the studio floor. Also, in the inverted position, the periscope can create the illusion of height which may save substantial cost in building platforms.

When attached to overhead pipes or grids, the snow machine shown in Fig. 4 is capable of covering an area

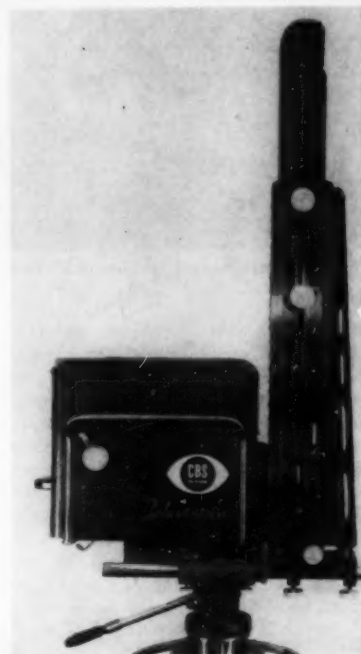


Fig. 3. Periscope camera attachment.

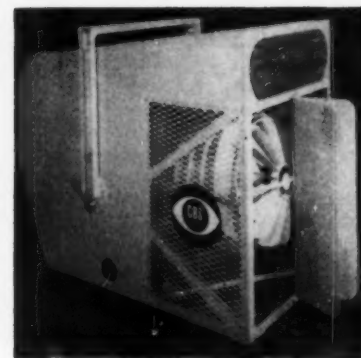


Fig. 4. Snow machine.



Fig. 5. Portable booth sections of 35mm rear projector in operating position.

of 600 sq ft with a uniform snowfall. In the rear section there is a hopper which holds $7\frac{1}{2}$ cu ft of plastic snow and in the event the scene is unusually long, a telescoping section of the hopper can be extended from the bottom to double the load capacity. A feed mechanism brings the snow out of the hopper to fans which blow it evenly over the playing area. There are warning lights which are tripped by the hopper when the supply is one-third gone, two-thirds gone and again when a two-minute supply remains. Control over rate of feed and area covered is provided at a remotely located control box.

The New York City Fire Department requires that projectors be operated in fireproof booths. To provide for movement not only within the studio but also from studio to studio, it has been necessary to make the booths portable. To achieve maximum portability, the booths have been built in two sections which fit tightly together (Fig. 5) for operating duty. The section on the right encloses the projector while the section on the left provides operating space for the projectionist. In addition to fulfilling the requirements of the Fire Department, the booths provide sound isolation and a good protective housing for the equipment.

A special feature of this projector is

its wide-angle optical system which projects a picture 12 ft wide at a distance of 12 ft, making motion-picture rear projection possible in some instances when insufficient space might otherwise have ruled it out.

In rear projection, moving the screen out into the studio to provide space for the projection throw usually consumes valuable playing area which often is sorely needed for other purposes. One way to save this space is to use front projection (Fig. 6). By hanging the projector overhead and projecting at a steep angle, the actors can work deep in the set without getting their heads in the beam of projection. For this application, a wide-angle lens is used to get maximum width. To correct for keystoneing, the slides are simply pre-distorted. Depth of focus for scenic backgrounds has been found adequate to maintain satisfactory focus from top to bottom. Because of the superior diffusive characteristic of an opaque matte screen over a translucent screen, the camera sees a picture of more even brightness with far less falloff with departure from the axis of projection.

Of the many techniques developed to create the illusion of space, the composite picture is thought to offer exceptional potential. As evidenced by some of the early inventions in motion pictures, such as the traveling matte

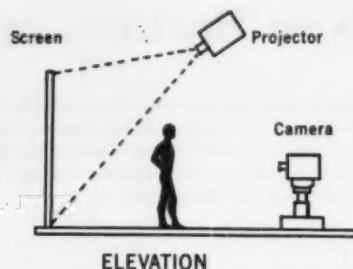


Fig. 6. Diagram of front projection.

(or mask) patented in 1918,* it appears that some of the pioneers of motion pictures shared this belief. The invention of matting techniques applicable to the scanning disk† in the early period of television is some indication that the pioneers of television also foresaw this potential.

With a facility to pick up actor and scenery on separate cameras and combine them in one composite picture, the possibilities of substituting miniature settings for full-scale scenery seemed obvious. Less obvious, though, was the exact manner in which this could be accomplished. About three years ago, at CBS, an earnest effort was begun to find out.

The black-and-white matte in television at that time was pretty unreliable and little used. Often referred to as "black matting," actors dressed in light clothing and powdered headdress performed on a black set usually consisting of black velour. The problem was basically one of differentiating the actor from his background because the black velour, particularly in the areas where the subject lighting hit the floor, quite commonly produced as much luminance as the shadow areas of the actor's costume. With differentiation between actor and background so marginal, the problem of slicing between background and subject information to produce a clean keying pulse proved exceedingly tedious and impracticable.

White sets were tried with what was called "white matting" and worked quite well with dark hair and clothing but had other serious limitations. Here the problem of differentiating between the white elements of the actor, teeth, blonde hair and modelling highlights, proved too difficult. In addition, the white backgrounds introduced the problem of halation.

In an effort to improve differentiation between the subject and his actual background, experiments were carried on with luminance, chrominance and polarization with varying degrees of success. Of these, the combination of lu-

* Frank D. Williams, U.S. Pat. No. 1,273,435, July 23, 1918.

† Dr. Theodor Vrabely, U.K. Pat. No. 455,785 (Convention date—Hungary) Apr. 27, 1934.

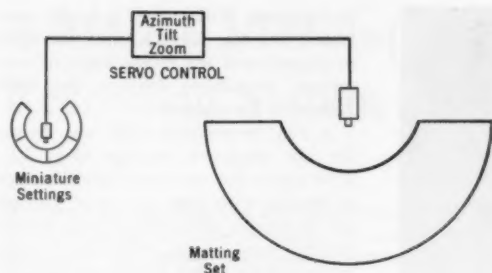


Fig. 7. Diagram of VideoScene setup with servo control.

minance and chrominance in color pickups offered a very promising means of improving the matte. Because of the small blue component present in flesh hues, the selection of blue for the background material further enhanced the margin of differentiation. The color matte soon evolved and was used successfully on the Arthur Godfrey programs in December 1956 and on subsequent color shows.

For black-and-white, only two pickup tubes are required. The "blue" tube is used solely for the purpose of providing the best possible keying pulse while the other, which is referred to as the "yellow" tube but which might more accurately be described as the "minus-blue" tube, supplies the actor's picture. Needless to say, both the picture quality and the stability of the matte benefit by using two tubes.

While the actor could now be matted into a miniature setting with quality and realism, it was apparent there was a serious limitation — the camera couldn't move. If either subject or background camera moved the slightest bit, the actor would appear to fly off into space. Under these circumstances, the matte was limited to brief establishing shots and trick effects. To overcome this limitation and provide a real production tool, the two cameras were connected with a servo system (Fig. 7) so that as



Fig. 8. Zoom range from one camera location.

the cameraman tilts and pans to follow the actor, the background camera tilts and pans synchronously with it. To go in for close-ups and come back for long shots, both cameras were equipped with zoom lenses which were connected with a servo system to zoom synchronously. The zoom lenses obviously had to be matched perfectly. A six-to-one focal range was chosen and provides a zoom from a figure one third of screen height (Fig. 8) to a head-and-shoulders shot — a good range.

The facility to move the matte brought with it more stringent background lighting requirements. No longer could the lighting of the blue background be tailored to compensate for nonuniformities in the optical system or pickup tubes of the cameras. Since the camera moved from one portion of the background to another, it became more important than ever that the background lighting provide the utmost uniformity of blue luminance. At this point, it seemed that the job which heretofore had required the installation and tedious adjustment of quite a large number of lighting units (Figs. 9 and 10) to cover the blue matting set was now to become more tedious by reason of the larger sets and the more stringent re-

Fig. 9. Plan of lighting setup formerly required to light floor and background.

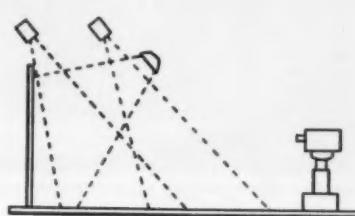
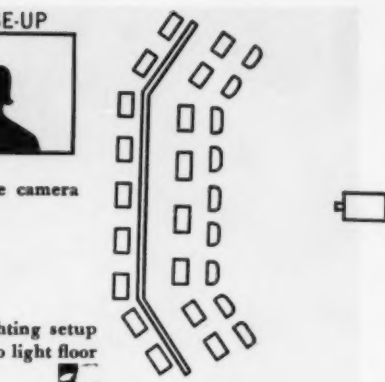


Fig. 10. Elevation of lighting setup formerly required to light floor and background.

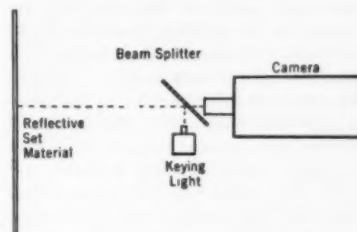


Fig. 11. Diagram of "Keying Light" setup used to illuminate VideoScene set.

quirements which movement entailed. But fortunately, this problem was solved by the use of a reflex-reflective sheeting material.



Fig. 12. Myoshi Umeki with Marlo Lewis looks at miniature setting she is about to perform in.



Fig. 13. Myoshi Umeki on VideoScene set.



Fig. 14. Picture taken off monitor showing Myoshi Umeki performing on VideoScene.

The Minnesota Mining and Manufacturing Co. developed background material with maximum reflectivity in the 425 to 450 mμ region. With a stage set made of this material, the entire job of lighting background and floor can be done with but one light located at the camera position (Fig. 11). By means of a beam splitter, blue light is reflected from the camera to the

background set material. Because of the high efficiency of the reflecting material, the blue light returned to the camera is greater than the sum total of blue vector components reflected by an actor from all the studio lights. In the blue tube of the camera, the background looks bright and the actor dark, thereby providing us with the differentiation needed to produce a keying pulse.

Background illumination is easily controlled because there is only one light to control and the requirement of uniformity is fulfilled because the light pans with the camera.

A 2-in. or one-sixth scale was chosen for the miniature settings (Fig. 12). This makes the miniature small enough to handle with ease but large enough not to require tedious work with watchmaker's tools. Also, the scale is large enough so that cloth will hang naturally and foliage can be used.

To the yellow (minus-blue) tube, the blue reflective set looks relatively dark and provides a suitable background for good subject quality (Figs. 13 and 14).

In this manner, means has been developed to substitute miniature settings for full-sized scenery and to follow the actors as they appear to move about naturally in them. It is believed this will prove a revolutionary new production tool.

Credit for development of the items included in this paper should be shared among the following at CBS Television: Gerald Carreau, Adrian Ettlinger, Robert Hammer, John Leay, Ray Lyon, Eugene Steigerwald and Eugene Warren.

Edit. Note: A 35mm film produced by the author was projected at the Convention to illustrate the techniques described in this paper.

A Mobile Videotape* Recording System

By J. BYRNE HULL and
H. G. HUMMEL

A system has been designed and constructional arrangements made for a special bus to contain a Videotape Recorder, two camera chains, signal generating equipment, director's console, monitoring facilities and self-contained power supply. System performance and accessory requirements are considered in detail. Various concepts in the use of the Videotape Cruiser are discussed, especially with regard to the advertising and motion-picture industries.

TAPE RECORDING was introduced into the radio broadcasting field in the late forties originally to make possible high-quality reproductions of shows which were available for the public only at awkward times, or in many cases to suit the convenience of the artists involved. Subsequently, many other features of tape recording such as ease of editing made it apparent that a powerful new tool had been placed in the hands of broadcasters for the low-cost production of programs free of flaws and the tyranny of time conflicts. That tool is now virtually indispensable. Moreover, its adaptability to such tasks as automatic programming and duplication has extended the usefulness of the tape-recording technique even further.

The introduction of tape recording into the video field gave many of the same benefits to television broadcasters. Local live programming is staging a profitable comeback; tape's facility for freshness is restoring the contemporary scene to television. Already a stereo-audio video recorder is in operation and several more are planned. The duplication of recorded video material will have far-reaching significance in program syndication where tape's ability to enliven sound and picture material is important. The value of the video recorder as a programming tool is expanding continually.

It was only a matter of time before someone asked for a "remote" video recorder. Remote camera chains were certainly not new, but could such problems as vibration, power supply, and space arrangements be satisfactorily solved for the video recorder? And what vehicle would prove most satisfactory?

Concept of Videocruiser

The Videocruiser (which was on display at the Convention) was Ampex's answer to those requirements. The goal of the Videocruiser project was to create

a self-contained mobile unit with next to no restrictions on normal uses of the Videotape Recorder. It was believed that almost every televising job would require two or more cameras. Two, therefore, were installed in the original model. Because one of the greatest advantages of video recording is immediate playback, after the tape is re-wound, both quality and switching versatility in the monitors are considered essential. The comfort of the operating crew, as well as the performance and reliability of the equipment, dictated the addition of air conditioning. (No crew can forget those occasional downtown remotes with temperatures of 100 degrees in the shade.)

Finally, the knotty problem of power supply arose. Should it be towed as a trailer—20-kw motor generator sets are pretty large—or could power be fitted neatly into the bus, yet assure that the vibration would not disturb the equipment, nor the noise exclude the use of the bus as a small studio when the occasion demanded? Many of the most dramatic remotes would break, it was believed, where no commercial power was immediately available. The decision to put the mg set on board the bus offered one final but important advantage. If the remainder of the system were designed carefully it should be possible to tape television with the bus in motion. Effectively, this would amount to live television on an endless cable and its successful achievement has been the Videocruiser's most newsworthy facility. Stability of motion, power supply, temperature and equipment function have all been satisfactorily attained. So while the Videocruiser could not quite be all things to all recordists, it certainly will provide a tool of sufficient merit to solve many problems confronting the many types of video production units.

Bus or Truck

In answering the question of what vehicle would be most appropriate, semi-trailer truck, van and the bus were considered for the cruiser. The truck or

van offered more space and lower initial costs, but the available bus configurations had air-conditioning, better riding qualities, speed and maneuverability, and more satisfactory crew communication. The latter turned out to be more important than was expected during "remote studio" or moving camera sequences. An r-f link phone system was also installed and the ability to phone to and from the cruiser wherever it might be gave the factory the same flexibility in scheduling it that a producer or broadcaster might need.

Technical Problems

The internal bus layout is illustrated in Fig. 1. A standard VR1000 (Videotape Recorder) is positioned forward in the bus, with enough room around it for a scope, and far enough from the monitor console for operator convenience. This layout was conceived so that the forward bus area could be used as a small studio when necessary. Normal vehicle vibration proved to affect the performance of the VR1000 not at all. The console and the racks are firmly attached to the floor with heavy-duty shock mounts, both to keep them in place during vehicle acceleration as well as to prevent chuck-hole jolts from overstressing the equipment's mounting attachments. Floor partitions lift for easy installation and possible maintenance requirements of cabling.

A close-up of the console monitor and camera control appears in Fig. 2. The complete camera control is bolted to a subframe which is shock-mount attached to the bus floor. This arrangement not only increases the shock-mounted mass, thus improving the vibration isolation, but also prevents adjacent cabinets from striking one another as they might if individually shock-mounted. On the recessed panel directly in front of the operator are the audio chain controls and the remote control for the VR1000. To the left is the power panel with circuit breakers and the metering for voltage, current and frequency of the power source, either external or internal. The audio, video, and video waveform monitors are directly above the camera chains. Off-the-air facilities are at lower left with a mobile telephone near at hand on the right.

Externally, the cruiser (Fig. 3) looks very much like an airporter, which of course it originally was. A door amply wide for equipment and cameras (and perhaps scenery, for example) is conven-

Presented on May 8, 1959, at the Society's Convention at Miami Beach by J. Byrne Hull (who read the paper) and H. G. Hummel, Ampex Corp., 934 Charter St., Redwood City, Calif. (This paper was received on June 30, 1959.)

* Trademark of Ampex Corp.



Fig. 1. The interior, looking back from the driver's seat.

iently located toward the rear of the right side opening into the area between the VR1000 and camera control. Cable storage is found under the floor in compartments which are both waterproof and dustproof. The roof area is covered with "diamond plate" enabling two complete camera crews to operate. Camera tripod hold-down rings, a guard rail and ladders are all an integral part of the rooftop installation. A hydraulic camera hoist is also included at the rear of the top deck.

Power Facilities

The auxiliary 10-kw power supply is located above the air-conditioning unit (shown in Fig. 4). A unique outside access door arrangement makes possible the easy servicing of either assembly. The noise level of this auxiliary inside

the bus is low enough to permit its use during outdoor and "temporary inside studio" pickups. This low noise level was obtained simply by ducting the engine cooling air inlet appropriately and installing two mufflers in the exhaust system. The hydraulic pump and equipment hoist cylinder can be seen on the left. This compartment also houses the $\frac{1}{2}$ -hp separate blower for the camera and monitor area and the r-f link telephone transmitter. The separate outside air supply prevents the camera and monitor heat load from upsetting the regulator system on the normal air conditioner. The fuse link control panel above the phone transmitter permits the use of 4-wire, 3-phase 115/208 or single-phase split 110/220 power. A relay can be arranged to start the auxiliary in the event of outside power

failure. There is still room to crowd a camera into this area when in a hurry to change bus locale.

Recorder Chain

Fortunately normal good grounding practice during installation of the various equipments prevented any system ground loop problems. Since the VR1000 is an integral unit as far as signal and ground circuits are concerned, no difficulty was encountered in getting excellent pictures on and off the tape even with the auxiliary operating. There is no trace of ignition interference.

Block diagrams of the video and audio chains are shown as Figs. 5 and 6. Video field switcher inputs include two camera chains, two external video lines, and off-the-air. The inputs may be patched to suit the director's convenience. Both the input and output of the video recorder can be monitored separately when required for program switching.

The audio system is generally parallel to the video in order to augment the facility. A separate audio tape recorder is available and can be patched into the system when the program material demands it. Otherwise the system has been kept as simple as possible consistent with the projected requirements. Many spare parts and maintenance problems have been reduced considerably because circuits, testing processes and tubes used in the recording chain now are identical to those for TV cameras.

A further important advantage over microwave link is the absence of hum bar roll-up. While recording, the VR-1000 synchronization is obtained (through the color sync input) from the crystal in the camera sync generator. Thus, playback of the recorded material at the studio offers no hum bar problems.

Experience with Videocruiser

By late summer the Videotape Cruiser will have traveled over 15,000 miles

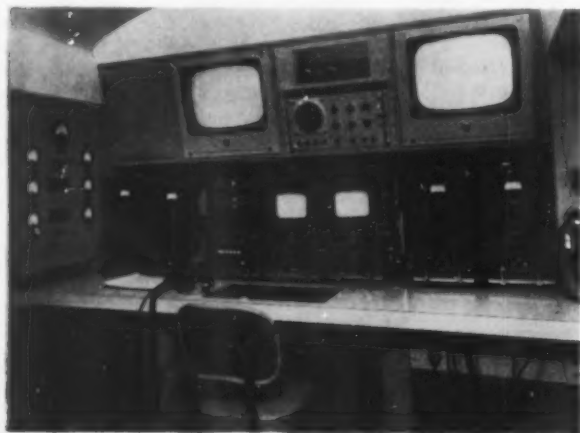


Fig. 2. The monitors and camera controls.



Fig. 3. The Videocruiser.

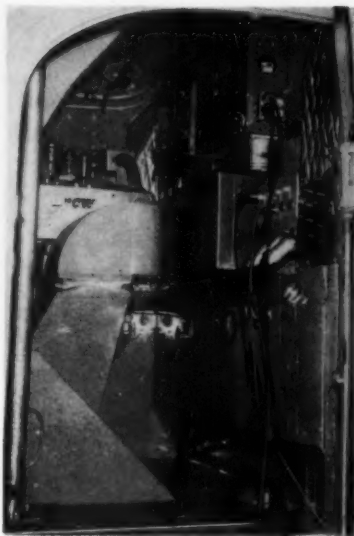


Fig. 4. The power supply and air-conditioning equipment.

throughout the United States. There has been no equipment difficulty which could be traced to the fact that the equipment was installed in a moving vehicle. Of the 400 or more recording hours over 70% of the time was on auxiliary power and about 40%, while the vehicle was in motion. The auxiliary-power facility coupled with the fact that all the equipment could be operated with the bus in motion has proved the most useful feature because of the opportunities for unusual recorded material which it has permitted.

Some of the new TV productions will treat the children to a posse chase such as they have never seen before. By using the telecopter, a picture of production activity can be transmitted from the air directly to the video bus and subsequently to the studios for editing and incorporation into the remainder of the program material. The use of the bus rather than a direct link to the studio gives the following advantages. First, the r-f distance is short, greatly improving the signal-to-noise ratio of the transmission. Second, again due to the short r-f distance, it is possible to secure and maintain focus between the telecopter and the bus antennas easily. Third, the

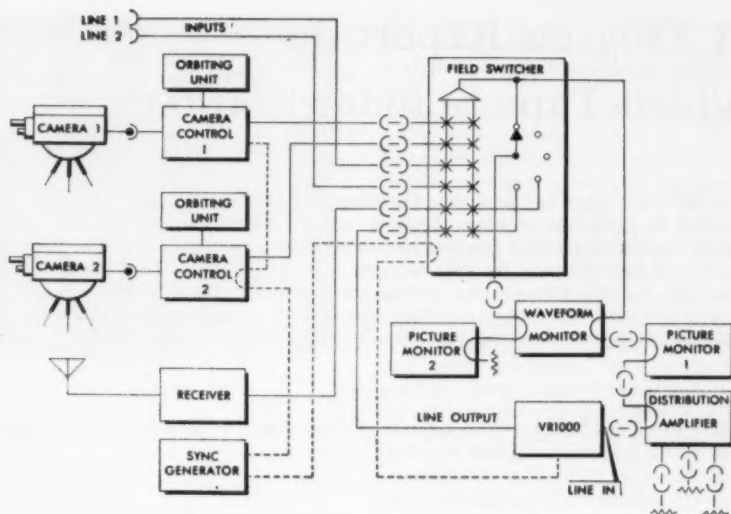


Fig. 5. Schematic of the video facilities of the Videocruiser.

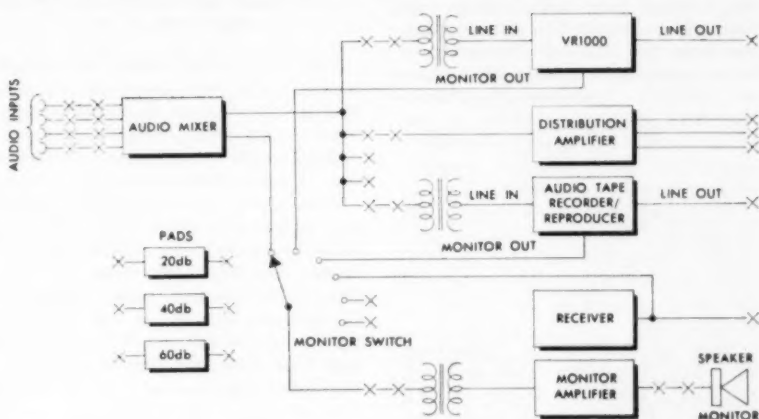


Fig. 6. Schematic of the audio facilities of the Videocruiser.

telecopter's view of the production activity is not hindered by buildings or other obstacles. Last, the low-level flying shots which it is possible to take are extremely view-worthy from the producer's standpoint.

The Videotape Cruiser's versatility as a remote recording unit will be recognized before long. This Fall, Art Linkletter's production unit will permit him to interview people all over the United States. Essentially it pushes the walls

of the studio outward to wherever today's television scene exists. One large advertising agency plans to use the mobile-video-recorder concept to present the pilot issues directly to the customer.

A video recorder has now been successfully made mobile, widening the horizons of television's most versatile tool for all of its users, from program producers through advertising agencies to broadcasters.

A Progress Report on Video-Tape Standardization

By A. H. LIND

The SMPTE Video-Tape Recording Committee has been working since its initial meeting in June 1958 on items requiring industry standardization in order to insure interchangeability of recorded video tapes. A list of pertinent items was prepared and tasks assigned by the Chairman. The list includes tape dimensions, tape reels, tape track dimensions; audio, control and cue track standards; monochrome and color signal characteristics; tape leaders; standard tapes; and tape splicing. This report covers the current status of the Committee's work.

THE VIDEO-TAPE RECORDING COMMITTEE was established and its first meeting held in June 1958. The chairman is Howard Chinn of CBS. Members include a representative from each of the three TV networks, one from each of the two equipment manufacturers, one from the principal tape manufacturer, one from a large independent station group, one from the National Association of Broadcasters, and a liaison member from the SMPTE Television Committee. The NAB member circulates to and solicits comments from all NAB-member stations that have video-tape recorders on the proposals for standards.

There have been six meetings of the Committee. The most recent was held in New York City on June 3, 1959. This report covers the progress made and the status of work in the Committee as of that time.

After approval by the Video-Tape Recording Committee each proposed standard is submitted to the SMPTE Standards Committee for review and approval. Following the Standards Committee approval it is published in the SMPTE *Journal* for three months for comment by those interested. If there are no adverse comments it is submitted to ASA Sectional Committee PH22 for further processing as an American Standard. Appropriate steps are taken to resolve adverse comments before the standard is adopted.

The primary objective of the Committee's work is the development of such standards as are required to insure interchangeability of video tapes. Many parameters are involved. They all are associated with the video tape in either physical or electrical forms.

Dimensions for 2-In. Video Tape

This proposed American Standard was approved by the Video-Tape Committee and submitted to the Standards

Committee. It provides for the following:

Width—The width of the tape shall be 2.000 in. $\pm 0 - 0.004$ in.

Thickness—The maximum overall thickness of the tape shall be 0.0015 in. and shall not vary by more than $\pm 5\%$ within a reel.

The $\pm 5\%$ tolerance on the overall thickness has been questioned in the Standards Committee as representing a number very small (0.000075 in.) and difficult to measure. Further consideration is being given to specifying this tolerance in a way that is more readily measured and yet will keep the thickness variation under the desired control. In addition, the matter of tape camber (see p. 614) is also being considered. Accordingly, on June 3 the proposed standard was withdrawn from the Standards Committee for further study by the Committee.

Reels for 2-In. Wide Magnetic Tape

After extensive consideration, discussion and a number of revisions, the proposed American Standard on Reels for 2-In. Wide Magnetic Tape has been essentially agreed upon in the Committee. Several incidental editorial

changes were made at the April meeting. Table I summarizes the highlights extracted from the proposed standard.

Table I. Highlights of Proposed American Standard on Reels for 2-in. Wide Magnetic Tape.

Reel Diameter, in.	Max. Capacity, ft	Max. Playing Time, min
8.000	1650	22
10.500	3600	48
12.500	5540	74
14.000	7230	96

A 6-in. diameter reel was proposed earlier. It was dropped at the April meeting when it was learned that difficulties had been experienced by those attempting to use them.

The standard contains thoroughly detailed dimensions for the reels. The hubs are specified to the existing standard NAB hub dimensions.

This standard has been submitted to the Standards Committee.

Recommended Practice for Patch Splices in Magnetic Video Recording Tape

This tape-splicing technique is proposed as an SMPTE recommended practice. The sketch in Fig. 1 shows the pertinent information about the physical splice. The splicing tape is 0.25 in. wide and a maximum of 0.0007 in. thick. The proper location of the cut is identified by the field pulse which is recorded in the control track. The precise location of the cut is determined as the center of the guard band between the two adjacent video tracks. The field pulse lies on the extension of this guard band

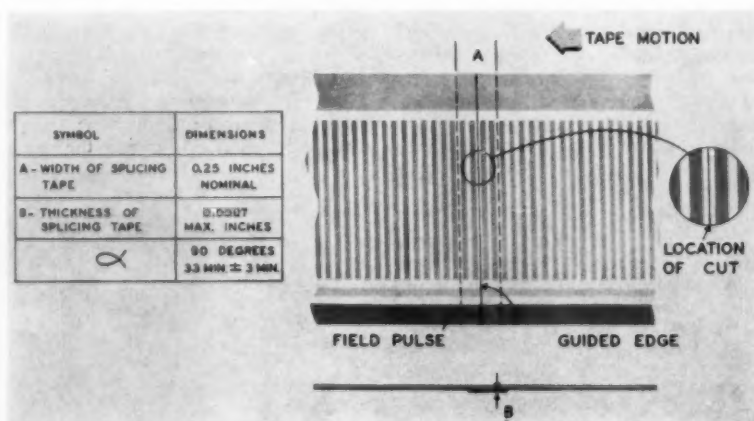


Fig. 1. Patch splices for magnetic video tape.

Presented on May 8, 1959, at the Society's Convention at Miami Beach by C. E. Anderson for the author, A. H. Lind, Radio Corp. of America, Camden 2, N.J.

(This paper was first received on May 8, 1959, and in revised form on August 17, 1959.)

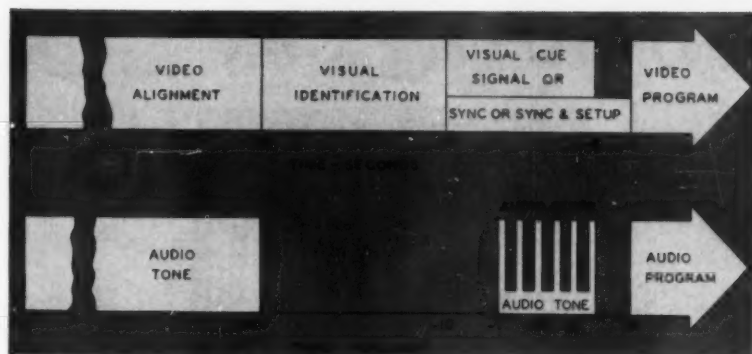


Fig. 2. Video-tape leader signals.

at the edge of the tape. Care should be exercised so that the separation between the two cut edges after splicing shall not exceed 0.001 in. at any point along the cut. Further, the longitudinal distance between corresponding points on the recorded transverse video tracks immediately preceding and following splice is not to depart from the average distance between successive tracks by more than ± 0.0005 in.

The proposal has been approved by the Committee on the condition that several minor editorial changes be made. These changes have been made in the draft of the recommended practice. The draft has been approved by the Standards Committee and will be published in the *Journal* for trial and comment.

Specifications for Video-Tape Leader

This proposed American Standard reached the point of unanimous Committee approval and has been forwarded to the Standards Committee for further processing.

The standard specifies three types of signals to be recorded for a minimum of 110 sec total (Fig. 2). The three signals provide alignment, identification and cue information. The alignment signal consists of a composite test pattern or equivalent recorded for at least 90 sec at the level and under the same conditions of equipment adjustment used for the video program material. Simultaneously, an audio tone in the 400- to 1000-cycles/sec range is recorded at the level and under the same conditions of equipment adjustment as used for the audio program material.

The identification information is visual information which is to be recorded for at least 10 sec. It shall contain, as a minimum:

- (a) Program title
- (b) Identification number
- (c) Date of recording
- (d) Length of recording (min and sec)
- (e) Recording studio name

It is expected that the information will be placed on a suitable chart and picked

up by a TV camera just prior to the recording of that sequence.

Following the visual identification information and immediately before the program material, the following audio cue signals are to be recorded. A 400- to 1000-cycles/sec beep of $\frac{1}{2}$ -sec duration occurring as a minimum of 9, 8, 7, 6, 5, 4, 3 and 2 sec ahead of the program. The recording level is to be the same as used for the alignment section audio tone. In addition, a steady component of the cue tone shall be recorded approximately 20 db below the level used for the beeps starting with the first beep and ending with the last one. A visual cue signal is also to be recorded during this same interval. The nature of such a signal is not specified, but it is recommended that it be a numerical readout coincident with and identifying the audio beep tones. However, in the absence of a specific visual cue signal, sync (or sync and setup) is to be recorded during the period of the beep tones and further sync (or sync and setup) only is to be recorded during the 2-sec interval from the end of the beep tones to the start of the program.

To be most useful it is important that the sync signal applied to the video-tape leader be the same signal or from the same source as that used in the succeeding program.

Audio and Control Track Standards

The proposed American Standard for audio-track recording specifies that mechanically the video-audio separation on the tape is 9.250 in. \pm 0.050 in. with the audio track leading. Electrically, the equalization shall be such that the NAB Standard Reproducing Characteristic (Section 2.80 of the NAB Recording and Reproducing Standards) applies. The draft of this standard is currently being revised to change the title and the scope. It is expected to be circulated in a letter ballot in the immediate future.

Specifications covering frequency range, signal-to-noise, and wow and flutter performance measurements are not included since they are not basic

to recorded-tape interchangeability and these items are already covered in the NAB Recording and Reproducing Standards.

The control-track characteristics are being very actively worked on. The frequency, waveshape and amplitude of the control signal need to be specified. Also, of essential importance is the phasing and tolerance on phasing of the control signal with respect to the transverse video tracks. Close control in this respect is vital to good performance when tapes are spliced.

In addition to the control signal, field pulses are added to the control track for the purpose of identifying the cutting point for splicing. One pulse per TV field is recorded. It is proposed to be located so as to be centered on the projection of the guard band between the second and third video tracks following the track containing vertical sync. A revised draft of control-track characteristics in proposed ASA form is expected to be submitted to the Committee shortly.

Standard Tape Track Dimensions for Video-Tape Recording

In an effort to reconcile the recorded tracks as produced by existing production-type recorders with the very desirable addition of an independent channel which might be used for cuing or other special purposes, the proposed track pattern shown in Fig. 3 was submitted to the Committee in September 1958. In this proposal the "cue" track is inserted between the control track and the transverse video tracks. It was determined that the necessary space could be made available by reducing the length of the recorded video tracks. The proposal is consistent with the conditions existing in the field.

At the time of the proposal the question of providing for stereo sound was raised in the Committee discussion.

Several recorders were modified to record two narrower stereo tracks along the edge of the tape where the single-channel audio track is normally recorded. Some loss in signal-to-noise ratio resulted. Also, crosstalk between the tracks existed which does not limit the use for stereo but which would seriously limit the tracks for any application where independent-channel, high-quality recording is desired.

There exists a strong feeling on the part of some members of the Committee that provision for dual, high-quality audio tracks is of great importance. Some feel that the dual audio tracks should be in addition to the independent cue track while others feel that the second high-quality audio track could replace the cue track and still, when needed, be used for cue-track purposes. Although a number of alternative track and recording arrangements have been

investigated, no workable one has been found to date. A standards proposal, based upon current practice, is therefore in the process of being prepared.

Both RCA and Ampex are currently manufacturing their recorders in accordance with the proposed track standards as shown in Fig. 3.

Recommended Practice for Monochrome Video-Tape Recording Characteristics

A proposal for an SMPTE Recommended Practice has been made as follows:

The recorded carrier frequencies corresponding to reference video signal levels shall be as follows:

- (a) Blanking Level — 5.0 mc
- (b) Reference White Level — 6.8 mc

This choice of deviation and reference carrier frequency is currently being studied by the Committee. An exchange of data is currently underway aimed at a choice of video pre-emphasis and de-emphasis characteristics.

Concern has been expressed by some Committee members that since this proposed reference carrier frequency and deviation are not usable for recording color signals, at least at the present state of the art, a different recommended practice will be required for color signals. This would result in a degree of noncompatibility between color and monochrome recording.

Color Video-Tape Recording Characteristics

Recommendations for color recording characteristics have not yet been presented to the Committee in written draft form. Considerable discussion has been carried on, however. In general it is necessary to limit the excursions to a minimum frequency of approximately 5.2 mc for the tip of sync in order to avoid spurious beat frequency components resulting from the beating of the FM carrier and the color subcarrier. Very active investigation by several Committee members is underway. It is possible to record reasonably satisfactory monochrome signals with the color recording characteristics now in use. The reverse is not possible.

Recorded Standard Video Tapes

Consideration and study of the types of test and alignment prerecorded tapes needed has been underway since the start of the Committee's work. A subcommittee is currently concentrating on this task. Standard tapes for checking the alignment or making necessary align-

ment adjustments for the following functions are being worked on.

1. Head assembly quadrature
2. Tape guide or shoe adjustments
3. Video reference level
4. Audio reference level
5. Audio head azimuth

Standard tapes for checking the performance of the equipment and which contain the following types of information are also being worked on.

1. Resolution test
2. Transfer linearity test
3. Window signal
4. Head servo stability test
5. Automatic guide compensator test
6. Audio frequency response
7. Audio wow and flutter test

It is intended that the standard tapes will be recorded to conform to all other pertinent standards. Also, it is expected that the tapes will include standard leaders.

Tape Camber Standard

Camber is the term used to refer to the tendency of tape to not lie with its edges straight when it is in a strain-free condition on a flat surface. A draft proposal is being worked on to include a definition of camber and a method of measurement. This information will possibly be published as a recommended practice.

Other Areas Receiving Consideration

In addition to the foregoing there are several associated or slightly different

aspects receiving attention. Several users of recorders have built devices to provide a visual countdown of time which is recorded as the visual cue information portion in the tape leader. These devices are being studied to determine the feasibility of recommending a specific countdown signal.

The matter of cue or other signals to be recorded at the conclusion of a recording is of concern to several people. A need has been expressed for visual identification marking on the tape by some means that will not interfere with normal usage of the tape.

To summarize, during its first year the SMPTE Video-Tape Recording Committee has formulated three proposed American Standards, one proposed recommended practice, and has in preparation four additional proposed standards and two recommended practices. This report represents only a brief summary of the Video-Tape Recording Committee's work. The Committee is working hard to expedite the needed standards while simultaneously being cautious to avoid developing standards that tend to inhibit future developments in the technique of video-tape recording.

H. A. Chinn, *Chairman*

C. E. Anderson
G. W. Bartlett
K. B. Benson
R. J. Bowley
W. K. Grimwood

A. H. Lind
R. M. Morris
G. M. Nixon
R. A. von Behren

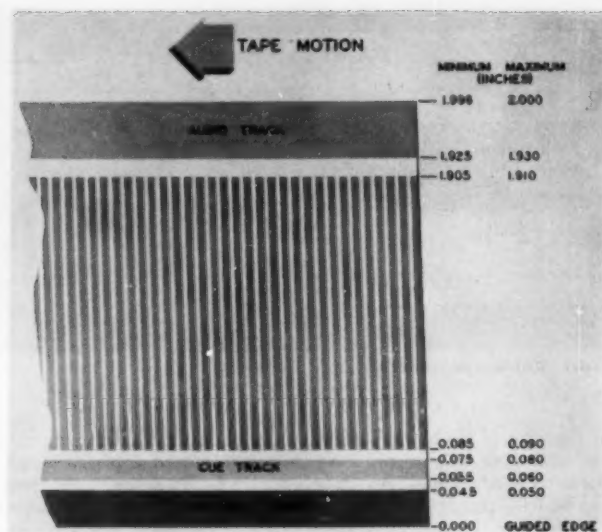


Fig. 3. SMPTE proposed standard track dimensions for video tape.

86th Semiannual Convention and Exhibit



Advance Papers Program and Exhibit Directory

Statler Hilton Hotel, New York

October 5-9, 1959

The penultimate stage of Convention planning, represented in the *Journal* by publication of the Advanced Program together with a few last-minute suggestions, has arrived for the 86th Convention. This stage of planning is one of concern that no last-minute crisis occur to alter in even small degree the scheduling of authoritative papers on vital problems affecting the industry or the many plans for the instruction and entertainment of members and their wives. The Advance Program is, of course, subject to last-minute changes, additions, and shifts in schedule that may occur between the date of its publication and the opening day of the Convention—or even during the Convention—but at publication date, the Advance Program is as final and accurate as it can possibly be made.

Information on reservations and hotel rates was published in the August 1959 issue of the *Journal* (p. 550) and by now the postal announcement should have been received by all members. Members are urged to be prompt in making reservations.

The Awards Session, always an event of significance, is scheduled for Tuesday evening.

For the Ladies

The glitter and excitement of a wonderful week in New York will be highlighted by a sponsored tour of the United Nations Building which will include a luncheon in the Delegates Dining Room. This will be no ordinary luncheon of tired mackerel or stringy chicken, but a real gourmet's delight with a wide selection of dishes from which to choose. Hostesses for the luncheon and tour are May E. Tanney and Judith Hamburger. The sponsor is S.O.S. Cinema Supply Company. Transportation will be provided. In addition to the "fun" part of the excursion, members of the tour will have an opportunity to see and perhaps to meet some of the international celebrities whose names have made news—and history.

This is only one of the many entertaining events scheduled for Convention week. The "show will get on the road" with a Get-Acquainted Party, 4 to 5 P.M. Monday, courtesy of W. J. German, Inc., when the week's "fun program" will be discussed and choices made.

One of the scheduled tours no one should miss is the boat trip around Manhattan in a quaint "yacht-type" boat. It is really quite an experience to sail around the island and get a sort of "seagull's-eye" view of such areas as the Brooklyn Navy Yards, Wall Street, and the towering skyscrapers.

Other scheduled events include the traditional luncheon and fashion show (are they *really* going to wear skirts above the knees!), and movies and television shows for which passes will be available.

When sending your Reservation Card to the Statler Hilton, be sure that your name and return address are typed in the top left corner of the address side.



The United Nations from the East River

Outline of Program

Sunday

10:00-5:00 Registration

Monday

9:00 Registration
9:30 Cinematography
12:15 Get-Together Luncheon—Guest Speaker:
Edward P. Curtis
2:00 Business Meeting
2:15 Film Steadiness Symposium
8:00 Sound Recording and Reproduction

Tuesday

9:30 Space Technology and Image Sensing
1:30 Space Technology and Image Sensing
8:00 Presentation of Awards
Guest Speaker: Edgar M. Cortright,
Chief, Advanced Technology Program, National Aeronautics Space Administration

Wednesday

9:30 Equipment Papers and Demonstrations—see the
Exhibit Directory
1:30 Committee Meetings—see separate listing
6:45 Cocktail Party, Banquet, Dance

Thursday

9:30 Television Equipment and Practices
2:00 Television Equipment and Practices

Friday

9:00 CONCURRENT SESSIONS
Instrumentation and High-Speed Photography
Scientific and International Television
2:00 Video-Tape Recording

Advance Program

This program is as complete and accurate as possible at press time—but there may be errors and there probably will be some changes for the Final Program. If attendance at a session is now being planned for only a specific paper or two, members are advised to inquire during the week before the Convention by telephoning to SMPTE Headquarters in New York (Longacre 5-0172) or to Paul Weiss, Program Chairman, c/o Du Pont Photo Products Dept., Parlin, N.J. (CLifford 7-4600).

SUNDAY—OCTOBER 4

10:00–5:00 Registration

MONDAY—OCTOBER 5

9:00 Registration

9:30 CINEMATOGRAPHY

Two New $f/1.9$ Lenses for 16mm and Vidicon Cameras

G. H. AKLIN, Apparatus and Optical Div., Eastman Kodak Co., Rochester, N.Y.

Two new Cine Ektar lenses, a 25 mm $f/1.9$ and a 50mm $f/1.9$, introduced by Eastman Kodak Co., give improved resolution in accordance with the demands of present-day 16mm motion-picture production. The field covered by these lenses is adequate for use with the vidicon tube. These lenses are also matched in spectral transmission to avoid altering the color balance when changing from one lens to another in using color film.

Methods of Appraising Photographic Systems

F. H. PERRIN, Eastman Kodak Co., Rochester, N.Y.

The reason why resolving power has been found to be unsuitable as a criterion of quality for lenses and photographic emulsions is explained. The spread function and the sine-wave response function are described, and the method of computing the latter from the former is indicated. The experimental method of determining these characteristics is described. It is shown how a flat-topped spread function leads to spurious resolution, and the usefulness of the concept of sine-wave response is illustrated by its application to successive printing operations.

The Luminance-Difference Threshold in Viewing Projected Pictures

E. J. BRENNEMAN, Research Laboratories, Eastman Kodak Co., Rochester, N.Y.

The luminance-difference threshold has been determined as a function of luminance for viewing conditions similar to those recommended by the ASA for the projection of professional motion pictures. A stimulus subtending an angle of 0.5° was superimposed briefly upon various areas within typical photographic reproductions. The results indicate the nature of the dependence of the luminance-difference threshold upon the luminance of the test area and upon the luminance of surrounding areas.

The National Seventy: A New Convertible Projector for 35mm and 70mm Film

WILLY BORBERG and BERNARD D. FLAKUN, General Precision Laboratory Inc., Pleasantville, N.Y.

Tentative Schedule of Committee Meetings

Tuesday, October 6

3:30 P.M. Association of Cinema Laboratories, followed by Cocktails and Dinner

Wednesday, October 7

10:30 A.M. Publications Advisory Committee
12:30 P.M. Editorial Luncheon
1:30 P.M. Papers Committee
2:30 P.M. Section and Student Chapter Officers
2:30 P.M. Board of Editors

Engineering Committees: The schedule will be listed in the Convention Program; and meeting notices will be mailed to Committee members.

Color Matching Between Picture-Tube Phosphors and Color-Film Dyes

LLOYD F. HOPE, Hazeltine Research Corp., Little Neck, L.I., N.Y.

Color sensation produced by transmission of light through a combination of color-film dyes can be matched by that produced by the combination of narrow-band lights radiated by the properly excited phosphors of a TV viewing tube. Equations for color matching are reviewed; graphic aids for conversion from coordinates based on dye primaries to coordinates based on phosphor primaries are presented; and these are applied to a practical problem.

Techniques in Color Duplication

ROBERT O. GALE, Color Technology Div., and WALTER I. KISNER, Motion Picture Film Dept., Eastman Kodak Co., Rochester, N.Y.

The production of black-and-white and color master positives and color duplicate negatives which lead to a final print quality comparable to that obtained in a print made from the original negative is a difficult problem for the motion-picture laboratory. This paper is intended to provide a better understanding of the proper techniques and to point out some of the pitfalls in color duplication operations for laboratory technicians engaged in this work. The requirements for good master positives and color duplicate negatives and the techniques for achieving optimum quality are discussed. As a practical guide, step procedures for producing master positives and duplicate negatives through different film systems are outlined.

Film Cataloging With IBM

GLENN D. McMURRY, Dept. of Cinema, Univ. of Southern California, Los Angeles

Report of Film Dimensions Committee

A. C. ROBERTSON, Eastman Kodak Co., Rochester, N.Y.

12:15 Get-Together Luncheon



Guest Speaker:

"Engineering in the Space Age"

EDWARD P. CURTIS, Vice President of the Eastman Kodak Company

MONDAY AFTERNOON

2:00 BUSINESS MEETING

2:15 FILM STEADINESS SYMPOSIUM

Steadiness and American Standards for Film Dimensions

DEANE R. WHITE, E. I. du Pont de Nemours & Co., Inc., Parlin, N.J.

Picture unsteadiness on a motion-picture screen could be caused by non-uniform perforation dimensions. Film slit and perforated within tolerance limits of American Standards should give acceptable performance when used in properly designed and maintained equipment. Dimensions most directly affecting film steadiness are discussed with review of some statistical data concerning dimension ranges occurring in practice.

Pin Registration

A. C. ROBERTSON, Manufacturing Experiments Div., Eastman Kodak Co., Rochester, N.Y.

The use of pin registration is almost necessary in making good motion

pictures, and is indispensable where process photography (or double-exposure) techniques are used. Several styles of guiding are described and the need for a set of different aperture plates in process printers is described. Pertinent factors in construction and operation are described of which control of relative humidity and temperature is an important matter. A type of guiding called "Edge and Point Guiding" has some virtues and is successfully used in some 16mm cameras. Some examples are given of errors caused by faults in design, workmanship and maintenance of equipment which detract from optimum performance.

Pin Locations in Special Effects Mechanism to Effect Steadiness

JOHN KIEL, Producer's Service Co., Burbank, Calif.

Cancellation

J. A. MAURER, JM Developments, Inc., New York

Demonstration of the Principle of Cancellation

A. C. ROBERTSON, Manufacturing Experiments Div., Eastman Kodak Co., Rochester, N.Y.

When the location of the pulldown claw in a camera and projector is the same, small errors of perforation in the film are cancelled, thus leaving as remaining sources of unsteadiness the errors in the camera and projector.

A demonstration using specially prepared film with large errors in longitudinal pitch shows that good workmanship alone is not sufficient to make a camera perform well under all circumstances. The disposition of the claw or positioning pin in the same location as that used in the projector is necessary to get ultimate performance under unfavorable conditions.

Interpretation of Dimensional Changes in Film

PETER Z. ADELSTEIN and JOHN M. CALHOUN, Manufacturing Experiments Div., Eastman Kodak Co., Rochester, N.Y.

A discussion is given of the factors which affect the dimensions of motion-picture film to correct some of the misinterpretations that are sometimes made. The distinction between standard film dimensions at the time of manufacture and actual film dimensions at the time of use is clarified. The stacking or cancellation of dimensional errors caused by variations in cutting or perforating, relative humidity, temperature, processing and aging, is explained. The application of the principles discussed to practical problems in the motion-picture and in the instrument and data-recording fields is illustrated.

MONDAY EVENING

8:00 SOUND RECORDING AND REPRODUCTION

The Testing of Microphones in a Simple Enclosure

R. W. CURTIS, National Film Board of Canada, Montreal

Lacking a free-space room, the National Film Board has investigated the use of a simple enclosure for routine microphone tests, with certain apparatus and techniques. The scope and limitations of the method are discussed.

A Highly Stable Variable-Gain Amplifier for Motion-Picture Film Recording

JAMES F. CORNELL, General Electric Co., Schenectady, N.Y.

The General Electric 4BA7A3-DS amplifier which is a GE BA7A Limiter Amplifier has been modified to operate as a backward-acting compressor incorporating a frequency-selective control voltage circuit to minimize accentuation of the upper and lower sounds in speech, an attack time of approximately 70 μ sec and an adjustable recovery time. Such a unit has been used in dialog recording in an industrial film studio. Samples of dialog recorded with the unit in its various modes of operation are illustrated in a 16mm film recording.

Modern Control of Theater-Sound Equipment

GEORGE B. GOODALL, Ampex Corp., Redwood City, Calif.

There are now three distinct techniques used in recording motion-picture soundtracks — single-channel optical, four-channel magnetic and six-channel magnetic. Each normally requires a separate control system, resulting in a confusing mass of equipment and controls in the theater projection room. The use of a modern sound-reproducing system can eliminate duplicate controls and equipment, simplify operating and emergency procedures, and provide instant pushbutton selection of soundtrack configuration.

A Magnetic Disc Recording and Reproducing System for Broadcast Applications

GEORGE A. SINGER, Radio Corp. of America, Camden, N.J.

A New Method of Post-Synchronous Recording

DENNIS GUNST, Fordel Films Inc., New York

During the recording, the modulations of the actor's voice together with associated control tracks automatically position the new track against the original track, so that the burden of maintaining synchronization is removed from the actor and placed on electronic controls. Experiments have been made illustrating the principles of the method; a film demonstrates a recording made by these techniques.

TUESDAY MORNING—OCTOBER 6

9:30 SPACE TECHNOLOGY AND IMAGE SENSING



Image Sensors and Space Environment

M. H. MESNER and MILTON RITTER, Astro-Electronic Products Div., Radio Corp. of America, Princeton, N.J.

The types of sensors available for imaging from satellites have certain capabilities, and operational and logistic requirements. The influence of the space environment on the sensors and sensing systems is evaluated. Consideration is given to the thermal environment and the possibilities of radiative cooling of infrared sensing elements.

Infrared Imaging From Satellites

RUDOLF A. HANEL and W. STROUD, National Aeronautics and Space Administration, Goddard Space Flight Center, Washington, D.C.

Obtaining infrared images of the Earth's surface and atmosphere by means of satellites is related especially to systems design and to image conversion techniques. Knowledge of the Earth's infrared properties aids in the understanding of experiments. There are various detection systems and problems peculiar to satellite-borne infrared sensors. Data presentation and interpretation are investigated; and an outlook to future applications of image-sensing devices concludes the paper.

Image Sensing as Applied to Meteorological Satellites

DAVID S. JOHNSON, U.S. Weather Bureau, Washington, D.C.

Earth satellites provide meteorologists with instrument platforms capable of observing the weather on a global basis. One of the most promising satellite observations is of cloud distribution and type. Several image-sensing systems are being considered with the aim of recording cloud images, both day and night, with a resolution of about 0.1 to 0.5 mile. Problems in sensing instrumentation, communications, processing and data presentation must be solved before an operational system becomes a reality.



Pictorial Data Transmission From a Space Vehicle

JON F. BAUMUNK and SEYMOUR H. ROTH, Astro-Electronic Products Div., Radio Corp. of America, Princeton, N.J.

Space communications are essentially line-of-sight transmission complicated by nonstationary terminals and the literally astronomical distances involved. Severe limitations on available power and weight restrict transmitter power, and therefore narrow bandwidths for transmission of pictorial data are required. These unique conditions underlie certain problems and possible solutions.



Orbit Determination From Optical Tracking

DOUGLAS DUKE, Advanced Research Projects Agency, The Pentagon, Washington, D.C.

Experiences with data from optical tracking instrumentation at the Atlantic Missile Range have shown that excellent satellite orbit determinations can be obtained from such data. Results are exemplified by tracking data on passes of satellite 1958 delta one (Sputnik III rocket). Various methods of orbit determination are discussed and applications of some of the simpler methods are illustrated. For shortcomings found with existing equipment, specific improvements are recommended.



Satellite Astronomical Telescopes

NANCY G. ROMAN, National Aeronautics and Space Administration, Washington, D.C.

The planned Space Sciences Program of the National Aeronautics and Space Administration includes a broad program of astronomical observations from satellites. Telescopes with apertures up to 36 or 40 in. appear to be practical for satellite use. These will be individually designed for particular spectral regions and particular experimental objectives and most will be based on photodetectors and electronic imaging devices which will substitute for the camera and the human eye.

Solar Photography

HERBERT FRIEDMAN, U.S. Naval Research Laboratory, Washington, D.C.

The familiar techniques of photography in visible light are not at all applicable to imaging the sun in short-wavelength, ultraviolet light. Refracting optics must be replaced by mirror optics and attainment of highly reflecting surfaces becomes a major problem. Color filtration has been accomplished by predispersing the image spectrum and selecting the desired wavelength range for final imaging. Television-type scanning with photoelectric pickup in selected wavelength intervals appears quite feasible.

TUESDAY AFTERNOON 1:30 SPACE TECHNOLOGY AND IMAGE SENSING



Uses of Television in Man-in-Space Research

CAPT. F. KIRK SMITH, U.S. Navy, Naval Air Development Center, Johnsville, Pa.

Physiological measurements and recordings are of great importance in the observation of human reaction to stresses encountered in various phases and types of research undertaken to prepare Man for his personal exploration of space. In monitoring reactions and responses to these stresses, television offers the researcher immediate visual information that can be used in interpreting simultaneously the physiological data obtained. Television is also a valuable tool in the evaluation of a subject's report on his own reactions during an experiment and the effectiveness of the equipment and instrumentation.



Electrostatic Imaging and Recording

E. C. HUTTER, J. A. INSLEE and T. H. MOORE, Astro-Electronic Products Div., Radio Corp. of America, Princeton, N.J.

Simultaneous pickup and electrostatic storage of optical information are

accomplished by using a transducer consisting of a pickup tube with a layer of photoconductor overlaid by a thin layer of highly insulating material. Recording is achieved by simultaneous optical exposure of the photoconductor and electronic beam contact to the insulator. A charge pattern corresponding to the optical pattern remains on the insulator. During the storage period, which may be for several days, the target is insensitive to light and radiation. When readout is desired, the charge image is read by an electron beam, as in a television pickup tube. The images may be stored on fixed rigid targets or on a flexible tape.



Satellite Astronomical Telescopes

NANCY G. ROMAN, National Aeronautics and Space Administration, Washington, D.C.

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Television and Lunar Exploration

S. W. SPAULDING, Astro-Electronic Products Div., Radio Corp. of America, Princeton, N.J.

Television techniques are planned to aid in the exploration of the lunar surface, with emphasis on the obtaining of high-resolution pictures from an impacting probe. A television link back to Earth will permit control of soft-landings on the Moon and subsequent surface examination. The optics, the television and the communications parameters are considered.

Mars Photographic Probe

PHILIP N. BOWDITCH and JOHN B. SUOMALA, JR., Instrumentation Laboratory, Massachusetts Institute of Technology, Cambridge, Mass.

The solar system is to be circumnavigated with a recoverable space probe which produces a high-resolution photograph of the planet Mars. A specific design for the space vehicle and the engineering problems of interplanetary navigation, attitude control, photography, communications and re-entry are presented.



Space Technology and Image Sensing — Summary

SIDNEY STERNBERG, Astro-Electronic Products Div., Radio Corp. of America, Princeton, N.J.

Spotlight on



Gevaert Positive Fine Grain, Type 561, is well known for its superb gradation and extremely fine grain. It is also favored for its consistent high quality which enhances sound, as well as picture.

Gevaert Positive Fine Grain is used in many laboratories throughout the world for all printing processes. If you are not acquainted with our Type 561, we invite you to try it.

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TUESDAY EVENING

8:00 PRESENTATION OF AWARDS



Guest Speaker: EDGAR M. CORTRIGHT, Chief, Advanced Technology Program, National Aeronautics Space Administration

National Space Program

The speaker will discuss the National Space Program in the light of past experiences, present activities and future planning. The presentation will be in the nature of a general survey of all aspects of the program, including space sciences, satellite applications, manned space flight, and developmental and supporting activities.

(The Program of Awards will appear in the Final Program for the Convention.)

WEDNESDAY MORNING—OCTOBER 7

9:30 EQUIPMENT PAPERS AND DEMONSTRATIONS

(See the Exhibit Directory)

WEDNESDAY AFTERNOON

1:30 COMMITTEE MEETINGS

(See separate listing, page 616)

WEDNESDAY EVENING

6:45 COCKTAIL PARTY, BANQUET, DANCE

THURSDAY MORNING—OCTOBER 8

9:30 TELEVISION EQUIPMENT AND PRACTICES

The Design of a 4½ Inch Image-Orthicon Camera Channel

GEORGE E. PARTINGTON, Marconi's Wireless Telegraph Co. Ltd., Essex, England

The 4½-in. image orthicon was introduced in 1955 as a contender with various European camera tubes for top picture quality with maximum operational flexibility. Its special characteristics are considered, particularly by comparison with 3-in. tubes. The way these influence the camera channel design is illustrated with reference to a new 4½-in. camera channel which combines maximum performance with a greatly reduced operating effort.

An Improved Image Orthicon

E. D. HENDRY and W. E. TURK, English Electric Valve Co., Chelmsford

A review of the faults associated with early image orthicons and description of measures taken for improved performance in a new version of the tube.

A High-Resolution Vidicon TV System as Adopted to Broadcast Standardization

JOSEPH BELCHER, General Precision Laboratory, Pleasantville, N. Y.

A Unitized TV Camera for Data Transmission

JAMES F. TENNYSON, Hallamore Electronics, Anaheim, Calif.

Because of the increasing need for high-quality yet economical TV equipment, a new TV camera has been designed. This is a unitized camera in concept, yet it retains such features as regulated power, wide-band video amplification, and stabilized sweep circuitry necessary for origination of clean, sharp and stable images. Additional special circuitry provides features previously found only in separate camera-camera control systems. Equipment of this type is planned for application in data transmission, surveillance and process control fields.

An Automatic Sensitivity Control for Monochrome Film Cameras

H. M. KOZANOWSKI, K. SADASHIGE and S. L. BENDELL, Radio Corp. of America, Camden, N.J.

The problem of accommodating unpredictable variations in average

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WORLD'S FASTEST COMMERCIAL PROCESSOR

FOR REVERSAL & NEGATIVE/POSITIVE 16MM FILM

Develops Reversal film at 125 fpm Develops Negative film at 55 fpm



MODEL RT-S

- New impingement-type film Dryer
- Temperature control
- Rinse tank with spraybar after each chemical tank
- Eight film squeegees
- New low-pressure type air squeegee
- Overflows and bottom drains
- Tachometer
- Solution and drybox thermometers
- Oil-less, rotary air compressor with pressure gauge
- Recirculation pumps and spraybars
- Stainless steel, type 316, tanks
- Daylight operation
- 1,200 Film Magazine
- Variable Speeds/Development Times

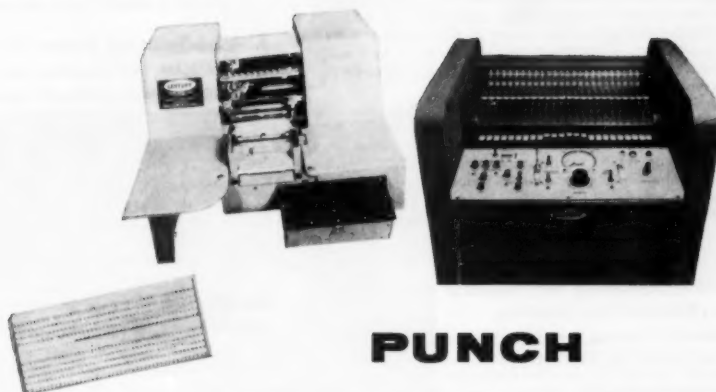
Wherever quality results are demanded in the fastest processing time . . . or wherever illumination is inadequate for quality image density . . . this newest, fastest combination 16MM Reversal and Negative/Positive film processor . . . the Filmline Model RT-S will consistently provide the solutions to these processing problems.

For in-plant, high-speed photography . . . for television stations, racetracks, and motion-

picture film labs . . . the Filmline Model RT-S is the ideal machine . . . providing quality results at speeds to 125 ft./minute . . . and permitting increases of the ASA index 1000% on DuPont or Eastman Reversal Emulsions.

Fully equipped, ready for immediate operation the Model RT-S offers you high cost film processing features for the low price of only \$6,450.00.

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***In the control of lighting intensities,
PUNCH is the first fully automatic
infinite preset lighting system in the world!***

*Electrically operated card punching and card reading machines
replace conventional preset panels and scene preset selectors,
making for speed and accuracy previously impossible.
All scenes or cues are reduced to card form. These cards or cues
can then be "read" at speeds up to 120 per minute!*

*Limitless creative lighting effects are now possible
with Century's PUNCH system—a manual control console
with card punching machine and card reading machine.*

*The lighting director is now free to concentrate
on lighting effects, rather than the technical difficulties
of achieving those effects. For details on operation
of this revolutionary system, write...*

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density of films and slides used in TV programming has spurred interest in devices for automatic control of signal levels from vidicon camera chains. A practical device provides control over a wide range of densities, with the particular advantage that the method of injecting control avoids introduction of "bounce" into the video signal.

A Simplified Method of Conversion of Standard Intermittent Motion-Picture Projectors for Use With Television Storage Pickup Tubes

J. S. CHANDLER, Research Laboratories, Eastman Kodak Co., Rochester, N.Y.

A 35mm Simplex standard projection head was converted for use as a television projector with the 3:2 field sequence method of utilizing film taken at 24 frames/sec for the 30-frames/sec television standard. A 31% application time is obtainable with a 5-in. shutter blade running at 3600 rpm. The entire mechanism — including the take-up drive, feed and holdback sprockets, shutter and intermittent Geneva — are driven from a single 1800-rpm synchronous motor.

A timing-belt drive is used for the intermittent mechanism. An eccentric grooved idler pulley of twice the diameter of the Geneva-drive pulley is interposed between the motor and the Geneva drive to produce the required advance and retard modification of the rotary motion. Curves showing the timing and change of acceleration are presented in the text. This low-cost method of providing a TV projector also produces very little added noise or acceleration loading so that long life is expected.

Automatic-Sequencing Equipment for Television Operation

F. CECIL GRACE, Visual Electronics Corp., New York

An automated television program system has been designed wherein events, with the time allotted for each, are stored in beam-switching-tube memory elements, along with the time each event is to remain on the air. When an event is on the air, the time counts down to zero in the beam-switching tubes. When it reaches zero the next event goes on the air and again starts counting down.

Television Camera Switching Practices

A. A. WALSH, National Broadcasting Co., New York

THURSDAY AFTERNOON

2:00 TELEVISION EQUIPMENT AND PRACTICES

A Special-Effects Amplifier for Noncomposite or Composite Monochrome or Color TV Signals

RALPH KENNEDY, National Broadcasting Co., New York

A switching circuit has been designed to produce a doublet impulse transition of 0.05 μ sec. The problem of clamping a color signal during the burst interval by means of crystal diodes is discussed and a solution presented. Nonlinear amplification of the switching data prior to regenerative clipping has been found to permit dependable switching with much smaller brightness changes.

A Noise-Stripping Process for Picture Signals

R. E. GRAHAM, Bell Telephone Laboratories, Inc., Murray Hill, N.J.

A nonstationary, nonlinear operation has been found which selectively removes moderate amounts of additive Gaussian noise from a received picture signal. No preparatory operation is required at the transmitter, so that the technique is compatible with existing picture transmission systems. The signal processing employed is based on experimental studies of observer preception of noise in pictures and on subjective factors affecting image sharpness. The process is applicable to conventional broadcast television, and could in principle be incorporated in home receivers to improve reception in fringe areas. A number of pictures are shown illustrating the noise-stripping process.

Eidophor: The Image Bearer

FELTON DAVIS, JR., Eidophor Inc., New York

After twenty years of developmental work, the Eidophor television projector is now ready for practical field use. This system of color television has numerous present uses and future potentials in closed-circuit, large-screen television.

An Advanced Audio Console for Television Broadcasting

EMIL P. VINCENT, American Broadcasting Co., New York

Audio facilities requirements for TV broadcasts have increased sharply during the past few years. Each successive year has brought altered re-

reverberation missing?



EMT 140 Highlights:

- 0.8 to 5 seconds instantly selectable
- Effect!
- No coloration (This is a natural)
- Minimum volume for maximum reverberation
- Easy 600 ohm insertions (zero loss)
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electronic applications, inc., 194 Richmond Hill Ave., Stamford, Conn.

Viditon Corporation Limited, 384 Bank Street, Ottawa 4, Canada

In Chicago: Ray R. Hutmacher Associates, Inc., 6647 N. Oliphant Ave., Chicago 31, Illinois
 In Dallas: Audio Acoustics, 130 Fairview Drive, Arlington, Texas
 In Los Angeles: Ralph Auf der Heide, P. O. Box 201, Altadena, Calif.
 In Miami: Dukoff International Sound Corp., 1625 Bay Road, Miami Beach, Fla.
 In New York: Harvey Radio Co., 103 West 43rd Street, New York
 In San Francisco: Ron Marco, 2880 Ridgeway Avenue, San Bruno, Calif.

AROUND THE WORLD WITH MAGNASYNC

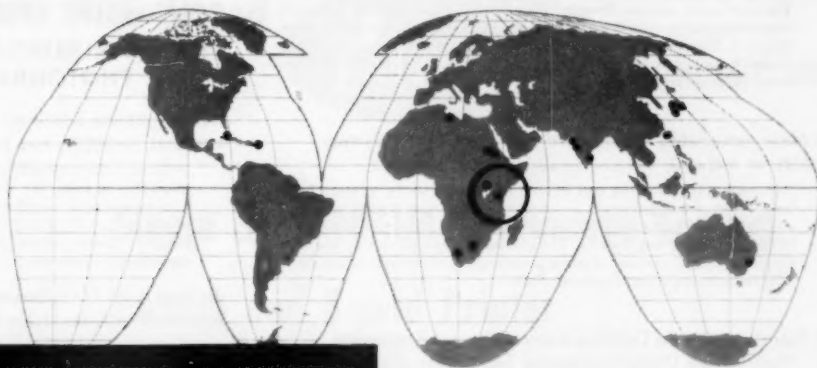


Photo courtesy of Peter Larsen, Nairobi

kenya

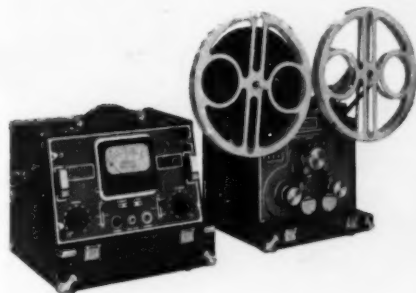
Deep in the interior of the "Dark Continent", just a few miles south of the equator, Armand Dennis guides the modern studios of East African Film Services of Nairobi, Kenya. The studios are completely equipped with the internationally famous Magnasync-Magnaphonic sound systems.

Photo at left shows the shooting of a scene for an African advertising film. Renato Spinotti is on camera, and Roger Norton operates the Magnasync Type 1 recorder.

East African Film Services find the portability and reliability of the 17½ mm Type 1,

Series 702 essential not only for studio work, but on location... where extreme environmental conditions prevail. Other studios and producers in Africa using Magnasync are:

Dept. of Information Nairobi, Kenya
David Millin Cyrildene, Johannesburg
Pan-African Film Services Cape Town
Messrs. B. & G. Cholakian Omdurman, Sudan
Dept. of Information Kampala, Uganda
Sudan Film Unit, Ministry of
Information & Labor Khartoum, Sudan
U. S. O. M. Tripoli, Libya



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International leaders in the design and manufacture of quality film recording systems



DEALERS: CHICAGO, Zenith Cinema Service, Inc.; LOS ANGELES, Birns & Sawyer Cine Equipment; NEW YORK, Camera Equipment Co.; SAN FRANCISCO, Brooks Camera Co.; AUSTRALIA, Sydney, New South Wales, Sixteen Millimetre Australia Pty. Ltd.; BELGIUM, Brussels, S.O.B.A.C., S.A. (Société Belge D'Applications Cinématographiques); BOLIVIA, La Paz, Casa Kavlin; BRAZIL, Rio de Janeiro, Mesblat, S.A.; CANADA, Toronto, Ontario, Alex L. Clark, Ltd.; DENMARK, Copenhagen, Kinovox Electric Corp.; ENGLAND, London, W-1, Delane Lea Processes, Ltd.; HONGKONG, Supreme Trading Co.; INDIA, Bombay, Kine Engineers; ITALY, Rome, Reporfilm S.R.L.; JAPAN, Tokyo, J. Osawa & Co., Ltd.; PAKISTAN, Karachi 3, Film Factors Ltd.; SWITZERLAND, Zurich 7/53, Rene Boeniger; THAILAND, Bangkok, G. Simon Radio Co., Ltd.

6-minute 16MM sound film "Planning an integrated sound system." Available for loan, free on request.

quirements necessitating continual realignment of the facilities to the point that design and installation of complete new facilities was in order. The new audio console design was conceived in the light of extensive experience and in consultation with the operating staff and with manufacturers. These considerations resulted in the development of an advanced console type which is expected to fully accommodate future television program requirements. The new console will be described.

A New Automated Punch-Card Lighting-Control System

ALBERT W. MALANG, American Broadcasting Co., New York

Automatic programming and remote control for studio lighting have been developed based upon a concept of using one silicon-controlled rectifier dimmer for each load circuit and a control system utilizing the IBM card punch and readout. The centralized control system provides for an unlimited number of scene presets and permits maximum flexibility with a minimum of manual effort.

A Television-Studio Lighting-Control System Employing High-Speed Digital Computer Techniques

DONALD D. BRITTON, International Telephone & Telegraph Labs., San Fernando, Calif.

This proposed system records the lighting-board operator's actions during rehearsals as a by-product of his normal setup procedure. During telecasting the machine then assumes the major routine workload while still permitting maximum operator control. Magnetic drum memory and solid state registers are used to affect maximum control. New command information may be distributed to every light in the house in less than one second.

The following advantages are effected in this approach: 100% reloading of lights; infinite presets; minimizing routine efforts; maximizing human control through human engineering; and economies in power consumption and air-conditioning requirements. This system was designed after several months of operations research at the NBC and CBS facilities in Hollywood.

A New Method of Measuring and Controlling Brightness Values for Studio Lighting

ROLLO GILLESPIE WILLIAMS, Century Lighting, Inc., New York



FRIDAY MORNING—OCTOBER 9

CONCURRENT SESSIONS

9:00 INSTRUMENTATION AND HIGH-SPEED PHOTOGRAPHY

Hue-Brightness Schlieren

ROCHELLE PRESCOTT, Avco-Everett Research Laboratory, Everett, Mass.

With all of the arrangements usual in schlieren photography there is no sensitivity to refractive disturbances which produce deflection of the light rays in some one direction; only that component of the refraction which is normal to this direction is visible. A method has been developed whereby mutually perpendicular components are shown as variations in brightness in the one case, and hue in the other.

An Improved f/10 Sweeping-Image Camera

BERLYN BRIXNER, Los Alamos Scientific Laboratory, Los Alamos, N.M.

A rotating-mirror sweeping-image camera with a mirror distortion corrector, greater writing speed, and an apochromatic relay lens has increased resolving power. An adjustable cylinder lens corrects astigmatism introduced by surface distortion of the mirror, rotating up to 2000 rpm to give a maximum writing speed of 13 mm/μsec for about 10 μsec. The lens operates at f/10, giving static resolution of 36 lines/mm on film. The dynamic image observed with the sweeping-image viewer suggests resolution of 3×10^{-9} sec.

Ballistic-Range Applications of Millimicrosecond Photography

J. A. HULL and G. A. THEOPHANIS, Avco Corp., Wilmington, Mass.

The Kerr cell electrooptical shutter has been adapted to obtain millimicrosecond, high-resolution photographs of models fired on a ballistic range. Eighteen stations employing these shutters are used to obtain aerodynamic data on nose-cone models fired at velocities to 14,000 ft/sec. Energy stored in the Kerr-cell pulse generator is used to generate the light pulse necessary for making the shadowgraph and schlieren exposures.

A Quick-Start High Speed Camera

W. O. S. JOHNSON, E. I. du Pont de Nemours, Wilmington, Del.

Modern as tomorrow and streamlined for maximum efficiency, the **ALL NEW OXBERRY 1500 Series Optical Step Printer** is a truly remarkable machine. Designed to meet the growing demand for a high performance, moderately priced unit, it embodies all the essentials necessary for fine optical printing and special effects work. It is built with the same high precision as the world-famous OXBERRY 1000 Series, but at a substantial lower price without sacrifice of function or scope.

The 1500 will do frame to frame and continuous step projection printing; freeze frame work; in color or black

New 1500 Series Printer

and white. Zoom range from 5 diameters reduction to 4 diameters enlargement. Both camera and projector will receive 35mm and 16mm components without loss of optical centers or film alignment when changing from 35mm to 16mm. Electro-mechanical drive has push-button controls. Full range of accessories available.

Standard model printer for 35mm includes the following: Camera with manual dissolve and fade; 35mm shuttle and sprocket assemblies; automatic take-up; 400 ft. magazine; counter; viewing device, superimposed type; precision compound lens mount; 100mm f/4.5 Ektar lens. Two speed stop motion motor, continuous, forward and reverse. Price, complete **\$12,900**

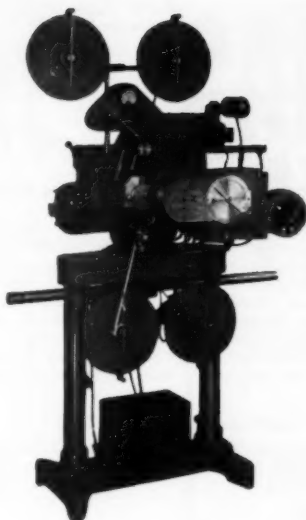
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OXBERRY

New High Speed

Peterson

Model 16-C-100



Single Head 16MM Continuous Contact Picture and Sound Printer

The NEW PETERSON 16MM CONTINUOUS CONTACT PRINTER has been designed to produce quality print at a new printing speed of 144 feet per minute.

A new type of aperture and film printing gate has been designed.

A precision contact roller is used rather than a shoe.

A new type of film support is used to carry the film edge of the sound side over a rolling drum, whereby perfect contact is obtained between the negative and positive print.

This printer is available with either a Semi-Automatic Light Control, or with a Fully Automatic Light Control.

New

Peterson

Model 16-C-60

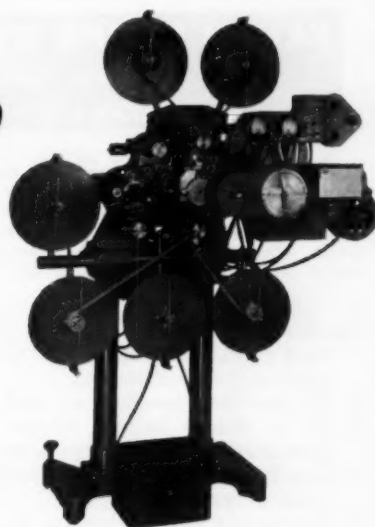
Double Head Contact Printer

The NEW MODEL 16-C-60 PETERSON DOUBLE HEAD CONTACT PRINTER prints sound and picture simultaneously, from separate negatives, in one operation.

Equipped with Semi-Automatic Light Control.

Available in 16MM or 35MM.

Can be equipped with Fully Automatic Light Control Shutter and built-in Automatic Fade Unit.



Produces quality print at a new speed of 72 or 144 feet per minute. Two-speed drive motor is used. Film take-up flanges have individual torque motors. Feed-out and take-up flanges will hold 1200 foot film rolls.



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CONCURRENT SESSION 9:00 SCIENTIFIC AND INTERNATIONAL TELEVISION

Cablefilm Equipment

C. B. B. WOOD, S. H. PADEL and P. RAINGER, BBC Research Dept. and Designs Dept., Broadcasting House, London

The Tunnel Diode

C. J. GALLAGHER, General Electric Research Laboratory, Schenectady

High-Resolution Television

L. POURCIAU, General Precision Laboratory Inc., Pleasantville, N.Y.

Wide-Band Television

ROBERT S. AHA, Tarc Electronics Inc., Westbury, L.I., N.Y.

Data-Link and Its Application to Television

DON ELLIS, General Electric Co., Syracuse, N.Y.

Flying-Spot Scanner Techniques as Applied to Video Tape

ROBERT S. MINER, Ampex Corp., Redwood City, Calif.

FRIDAY AFTERNOON

2:00 VIDEO-TAPE RECORDING

A Transport Mechanism Design for the Television-Tape Recorder

J. G. LEE, Broadcast and Television Equipment Div., Radio Corp. of America, Camden, N.J.

Double-System Recording and Editing With Video Tape

OSCAR F. WICK, National Broadcasting Co., Burbank, Calif.

It is customary, in the motion-picture industry, to record and edit sound and picture separately. The procedure affords vastly improved production flexibility over single-system methods. This added flexibility can also be used to considerable advantage with video tape. A system has been designed to provide separate magnetic sound and magnetic picture records.

Video-Tape Recording Interchangeability Requirements

K. B. BENSON and P. E. FISH, CBS Television Network, New York

The use of video tape in broadcasting service usually requires that recordings be played back with a different head assembly from that employed for the original recording. If such interchangeability of head assemblies is to provide optimum quality, it is essential that close control of many manufacturing parameters and operating standards be maintained. Mechanical dimensions of particular importance include those relating to the video-track azimuth, pitch, and width as well as the angular placement of the four rotating heads. Essential electrical parameters include the value of carrier frequency corresponding to reference video levels. In addition, response-frequency characteristics of audio, video, and carrier frequency channels must be standardized. These factors are discussed as related to current practices in CBS Television Network video-tape operations.

Interchangeability: Fact or Fiction

JOHN KING, Ampex Corp., Redwood City, Calif.

Analysis of Television Tape Dropout Factors

BERTEN A. HOLMBERG, Magnetic Testing, Minnesota Mining & Mfg. Co., St. Paul, Minn.

Recent improvement in video recording tape quality opens the way for better system performance. Studies on dropout amplitude and duration vs. certain machine characteristics demonstrate the need for coordinating these factors with tape evaluation. Tests with various head penetrations show inter-relationship of operating standards and dropout performance. Data on increased tape and head life with reduced penetration must be weighed against other performance criteria at the present state of the art. Simple instrumentation methods for insuring proper machine performance minimize dropout difficulties.

Analysis of Noise in Television Tape Recordings

JOHN VARNELL and HAROLD WALSH, Ampex Corp., Redwood City, Calif.

Video Tape Analyzer

A. A. GOLDBERG and MERLE R. HANNAH, CBS Laboratories, Stamford, Conn.

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Manufactured by West Germany's foremost producer of high-quality light sources, Xenon by Osram produces a non-pulsed white light point source of high-efficiency and extreme brightness. Available in sizes from 150 to 1800 watts. Also available in High Pressure long arc, water cooled lamps, 6000 watts, AC or DC.

Recommended uses:

- As a point source for optical systems and for microscope illumination.
- For beacons, spotlighting and backlighting.
- As a diffuse source where evenness of illumination over a large area is desirable.
- The illumination of slit monochromators and repeat type printers.
- The testing of materials (as in fade testing).
- For technical and biological studies which require a close duplication of daylight.

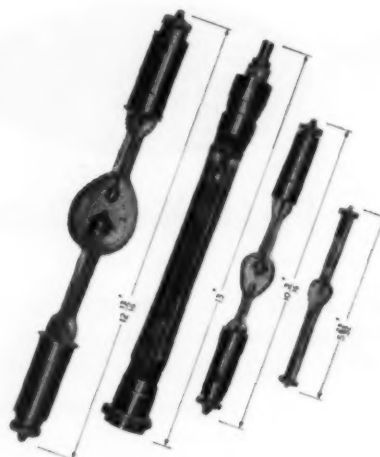
For more complete detail, the cost of auxiliary equipment, O.E.M. prices and quantity discounts, please address correspondence to:

MACBETH SALES CORPORATION

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Exclusive Sales Agents and Distributors



SHORT ARC HIGH PRESSURE XENON LAMPS

Arc also 1.2 x 2.4 to 2.1 x 4.2 MM

	List Price
XBO-162 (160 watts, AC or DC)	\$ 65.50
XBO-501 (500 watts, DC)	\$ 143.80
XBO-1001 (1000 watts, DC)	\$ 200.50
XBO-2001 (2000 watts, DC)	\$ 304.40

LONG ARC HIGH PRESSURE WATER COOLED XENON LAMPS

Arc length 110 MM

	Water Jacket
XBF-8000 - AC	Clear Glass \$ 131.20
XBF-6001 - DC (6000 watts)	Silvered Glass \$ 133.70
XBF-6001 - DC	UV Transmissive \$ 140.50

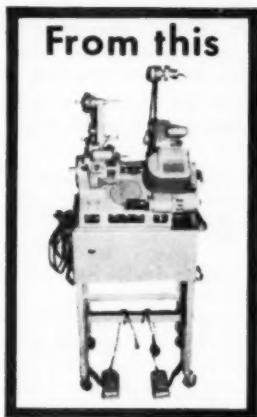


PUZZLED ABOUT EDITING
MULTIPLE SOUND TRACKS?

IF SO THEN TRY THE **NEW**

CAMART ADD-A-UNIT EXTENSION PLATE

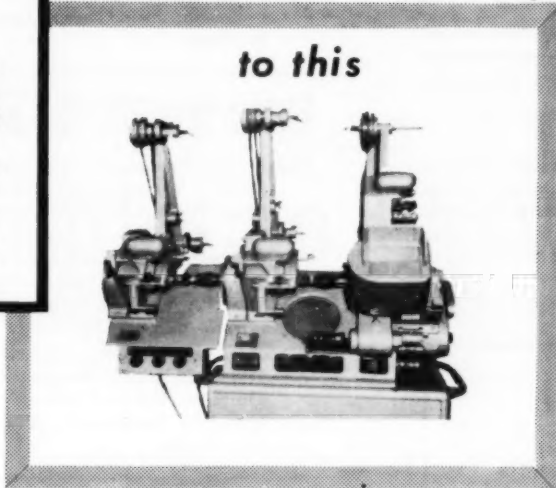
From this



For Series 20 Moviola

U. S. Pat. Pending

to this



Here's How It Works!

Today when you have a completed feature or short a Musical score is recorded to suit. Each recording for effects background is done on separate tracks. Here is where the Camart Add-A-Unit can save you time and money. With the Add-A-Unit you can edit and cut three or more tracks simultaneously. No need to go back again and run the whole picture through. Everything is done in one operation.

HERE'S WHAT YOU GET:

1. The Add-A-Unit extension plate ribbed construction of durable aluminum alloy, precision machined to fit any series 20 Moviola film editing machine in perfect alignment.
2. Extra belt guards and screws.
3. Complete flexible coupling assembly to interlock sound heads.
4. Extra flange.
5. Amplifier connections with all ready made fittings for easy installation.
6. Separate volume controls permit individual control over each sound head, including the composite.

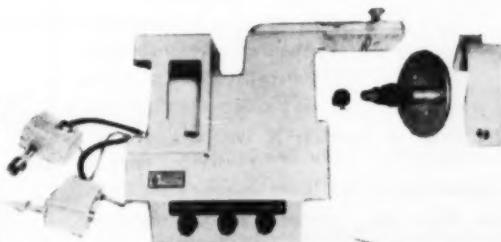
7. Separate controls for optical & magnetic Sound.

Camart Add-A-Unit
Extension Plate

\$325⁰⁰

COMPLETE

Additional Separate Sound heads with take-ups—Prices on Request.



See Us at Booth
36, S.M.P.T.E.
Convention

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1845 BROADWAY (at 60th St.) NEW YORK 23 • PLaza 7-6977 • Cable Cameromart



Exhibit Directory

Ampex Corp.
Redwood City, Calif.

Booths 9, 10, 11

Exhibiting: Ampex VR-1000B Videotape Recorder, black-and-white and color; Marconi TV Camera; Ampex theater sound systems; multi-channel audio recorders; high-speed tape duplicator.

Personnel: Tom Davis, Bob Day, Jack Hauser, Neil McNaughton, Tom Merson, Bob Paulson, Ross Snyder, Charles Swisher, Phil Thornton.

Animation Equipment Corp.
38 Hudson St., New Rochelle, N.Y.

Booth 4

Exhibiting: Oxberry Unistand, for animation, titles, filmstrips, enlarging and copying in 3 to 24-field range, with traveling table or compound and camera carriage; Oxberry Master Series 4200 animation stand and camera, with follow-focus, lens mount, stand and platens.

Personnel: John Oxberry, Ed Willette, Robert Troy

Arriflex Corporation of America
257 Park Ave. South, New York 10
7303 Melrose Ave., Los Angeles 36

Booth 47

Exhibiting: Arriflex 16, with automatic buckle switch, sprocket roller guides and motor cable lock; Arriflex 35, Model II BV, with variable shutter; new lens developments for Arriflex; Taylor Hobson Cooke Lenses; Macro-Kilar F2.8 Lens in Arriflex Mount.

Personnel: Paul Klingenstein, Victor James.

Equipment Papers and Demonstrations

Wednesday morning, October 7, from 9:00 to 12:30, exhibitors will present the following equipment papers and demonstrations.

A complete list will be published in the Convention Program

Arriflex Corp. of America: A Synchronous Sound Recording System for Arriflex Cameras.

Bell & Howell Co.: A New 16mm Motion-Picture Printer

Camera Mart, Inc.: Camart Add-A-Unit Extension Plate for Moviola Editing Machines; other Camart products.

Century Lighting, Inc.: PUNCH Automatic Instantaneous Infinite Preset Lighting System.

Florman & Babb, Inc.: F & B Slide Dissolve Unit.

Karl Heitz, Inc.: Kinoptik Lenses, Camex 8, Robot, Alpha.

Prestoseal Mfg. Corp.: Film, Tape and Paper Splicing Equipment.

Rapid Film Technique, Inc.: Problems of Scratches on Motion-Picture Film and Their Removal.

Time Automated Mfg. Co.: 16 mm Color Processor.

Bausch & Lomb Optical Co.
Rochester 2, N.Y.

Booth 12

Exhibiting: How developments at Bausch & Lomb in the motion-picture field have been used in space applications, along with the latest equipment in the motion-picture world and a new series of vidicon lenses.

Personnel: J. Wright, B. Day, D. Peterson, T. Venvertloh.

Bell & Howell Co.
7100 McCormick Rd., Chicago 45

Booth 1

Exhibiting: New 16mm printer, Design 5205 Model JM. New features include new type base, improved film transport, 2000-ft flanges with tight winds optional, direct drive motor, built-in edge light printing, plug-in accessory units.

Personnel: Jerome Debish, George Oakley, Harold Peterson, John Terry, James L. Wassell, Hans Wohlrab.

Camera Equipment Co.
315 West 43 St., New York 36

Booth 3

Exhibiting: New electronic printing device for Bell & Howell Model J Printers; CECO blimp for Maurer Camera; CECO programming device for time-lapse photography; stop-motion motors; CECO fluid-head tripod; vidicon tripod and dolly; CECO 16 & 35mm professional film viewers; variable-speed camera motors; indoor remote pan-and-tilt head.

Personnel: Frank Zucker, Burton H. Zucker, Eugene Levy, Edward Brown, Jack Brown, Arthur Dorman, Sol Fol, Alan Green, Bernard Grubman, Al Nathanson, Wally Robbins, Clifford Van Praag.

Camera Mart, Inc.
1845 Broadway, New York 23

Booth 36

Exhibiting: Camart Baby Dolly; Camart Add-A-Unit Plate; Camart Dual Reader; Camart Editing Table; Camart Editing Bins and Rack; Camart Core Dispensers; Camart Titewind Adapter; Camart Writing Attachment for Moviola; Camart TV Matte for Moviola; Camart Electric Footage Counters; Camart Triangle; Camart Car-Top Clamps; Camart Optical Effects Unit; Camart Slate and Clapstick; Camart Oiler Pen; Camart Parlight; Moviola Film Editing Machine; Auricon Sound Cameras; Auricon Tripods; Bror 16mm Processing Machine.

Personnel: Irving Browning, Samuel Hyman, Paul Meistrich.

Canadian Applied Research Ltd.
750 Lawrence Ave. W, Toronto 19, Ont.

Booth 42

Exhibiting: Type 246 Mark 3C Automatic Tri-Film Processor.

Personnel: D. E. Richardson.

See the New and Different

Bell & Howell

Model JM

16mm Motion Picture Printer

...the ultimate in velvet smooth printing

...handles originals with utmost care

...designed specifically for 16mm

on exhibit at BOOTH #1 SMPTE convention



Bell & Howell PROFESSIONAL EQUIPMENT

Century Lighting, Inc.
521 West 43 St., New York 36
1477 N.E. 129 St., North Miami 61, Fla.

Booth 40

Exhibiting: PUNCH fully automatic instantaneous infinite preset lighting system; C-Core (Silicon Controlled Rectifier) Dimmer; light-weight photographic and studio Fresnelites, Pattern Lekolites and accessories; data on studio lighting systems.

Personnel: James J. Fedigan, George Izenour, Edward F. Kook, David Locklin, Stanley McCandless, Nathan Sonnenfeld, Rollo G. Williams.

Cine Speed, Inc.
Roosevelt Raceway, Westbury, N.Y.

Booth 14

Exhibiting: Demonstration of the Cine Speed Instant Processor, attached to a 16mm motion-picture camera; TV film chain.

Personnel: George M. Levy, Jr., Russ Dupre, Richard Hanellin, Frank Kelly, Marylou Linicus, Ed Palmolka, Elaine Randell, Al Stein.

Electronic Systems, Inc.
Subsidiary of Electric Eye Equipment Co.
1938 East Fairchild St., Danville, Ill.

Booth 41

Exhibiting: HURLETRON Automatic Shutter for 16 & 35mm Bell & Howell Printers; HURLETRON Punch Tape Control System With Tape Verifier; HURLETRON Automatic Control Board System; Dial-Matic Perforator.

Personnel: Theodore W. Batterman, Clark Huffer, George DeWitt.

Florman & Babb, Inc.
68 West 45th St., New York 36

Booth 17

Exhibiting: Portman Animation Stand and complete line of accessories; Triplex Triple-Duty Animation, Title Stand and Product Stage; new F & B Power-Mite batteries and power supplies; new F & B butt-splicing block; Miller Fluid-Head Tripod; miscellaneous new F & B products.

Personnel: John Babb, Arthur Florman, Len Hollander, Charles Lipow, Tom Notto, Warren Portman, Hy Roth.

Karl Heitz, Inc.
480 Lexington Ave., New York 17

Booth 24

Exhibiting: New Alpa 4b, 5b, 6b and 8b 35mm Single-Lens Reflex Cameras w/Lightning Mirror; new Robot Royal 36S, 35mm Auto-Sequence Camera; new Camex Reflex (first 8mm single-lens reflex camera); Kinoptik 16 and 35mm Apochromats.

Personnel: Karl Heitz, Arthur Birnbaum, Yvonne Brandes, Fred Hofelder.

Houston Fearless Corp.
11801 W. Olympic Blvd., Los Angeles 64

Booths 7,8

Exhibiting: 16/35mm Negative-Positive Black-and-White Immersion Processing Machine, Model 120PN, for speeds up to 120 ft/min; plastic valves, pumps and related laboratory accessories.

Personnel: Art Kjontvedt, Lou Girola, Jack Jiruska.



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CONSOLIDATED FILM IND.
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MOVIELAB FILM LABORATORIES,
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HERE
IS
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Basic Stand

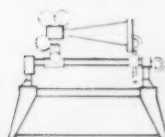
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Complete as shown \$1595

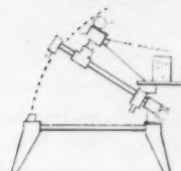


NOW—FOUR BIG NEW FEATURES

	WAS	NOW
over-all height, vertical post	76"	97"
over-all length	62"	102"
zoom range to tabletop	1-12 field	1-18 field
zoom range to floor	1-24 field	1-30 field



2—IN HORIZONTAL POSITION
For zoom titles, copy and
product and puppet stages—



3—IN DIAGONAL POSITION
Columns can be locked at any
angle between horiz. and vert.
—for angular zooms in on table
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position.

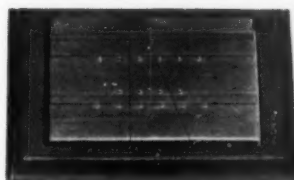
The TRIPLEX stand complete with camera,
is now available for monthly rental.
Write for complete information.

Serving the World's Finest Film Makers

F & B Butt Splice & Film Repair Blocks

These excellent blocks make
butt splicing and repairing
damaged film strips simple as
A-B-C. Easy to use, no com-
plicated parts, and solidly con-
structed they are available in
the following models:

Model B-16 for 16mm.
film \$ 9.50
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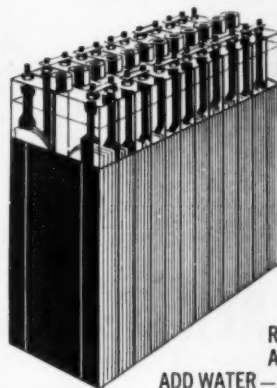


Magic "Mylar"

This amazing sprocketed splic-
ing tape will repair torn and
damaged films, replace torn
perforations and allow you to
butt-splice without losing a
single frame. Comes in trans-
parent for film, opaque for
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never come apart and perfo-
rations stay permanently re-
paired with Magic "Mylar."

Transparent—For Film
per roll
16mm.—Single Perf. \$5.00
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Opaque—For Magnetic Film
per roll
16mm. \$ 6.60
35mm. 11.00

NEW F & B POWER-MITE NICKEL CADMIUM BATTERIES



LARGEST CAPACITY—
6-10 amp. hours
SMALL-LIGHT—
6 oz. per 1.25 v.cell
INDESTRUCTIBLE—
Can be stored
indefinitely in any
condition
SAFE—No Acid Spray
or corrosion
CHARGES EASILY—
To 90% in 20 minutes
and 100% in
30 minutes

RETAINS 70% CHARGE—
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ADD WATER—Only a few drops
ONCE A YEAR

PERMANENT ELECTROLYTE—30% solution of
Potassium Hydroxide

Batteries are supplied in a
metal case with a leather carrying strap and plug.

7½ Volt—Power-Mite battery
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F & B's Power-Mite batteries can be supplied in any com-
bination to power practically all cameras, recorders, etc. All
the features listed are absolutely guaranteed by F & B. The
Power-Mite nickel cadmium battery is unconditionally guar-
anteed for one full year.

SPECIAL BATTERIES CUSTOM-BUILT TO YOUR ORDER



NEW IMPROVED F & B CAMERA SLATE

Here at last is the new F & B Camera Slate designed to
professional specifications. Look at some of the exclu-
sive features: Permanently attached ring-mounted num-
bers • Spring-loaded hardwood clapstick • Sturdy
masonite construction • Erasable hard slate finish
• Large 12" x 16" size

Reg. \$29.50 NOW...\$14.95

MILLER FLUID DRIVE HEAD

Model D (medium duty) \$150.00
Swivel leveling joint 59.50
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Fits all Tripods. Write for complete information and literature NOW.

F & B proudly announces the exclusive distribution of the Miller Fluid Heads in the
Eastern United States. The Miller Head is the world's finest precision built hydraulic
drive pan head, and is designed for super-smooth panning and tilting. Can be used
with any movie camera.



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JM Developments, Inc.
116 West 29th St., New York 1

Booth 45

Exhibiting: New JMD 16mm Laboratory Printer, designed by John A. Maurer. Operates at 120 ft/min and provides sound transfer from 16mm original magnetic to optical release prints, 1-to-1 printing of optical sound, contact printing of picture in black-and-white and color with a timing light range of 30 steps using light-valve control and a number of other advanced features.

Personnel: John A. Maurer, Russell Holslag, Alexander S. Blumenfeld.

Macbeth Instrument Corporation Booth 37
P. O. Box 950, Newburgh, N.Y.

Exhibiting: EP-1000 Photographic Color Analyzer, "on-easel" control instrument for prediction of filter pack necessary for satisfactory print and for indication of exposure time; Quantalog Densitometers.

Personnel: Warren B. Reese, Frederic McCurdy, George Piersol.

National Cine Equipment, Inc. Booth 39
209 West 48 St., New York 19

Exhibiting: Special flatbed motor, variable speed, for Arriflex 35; new hydro-fluid tripod for 20-40 lb cameras; viewers, synchronizers, motors, dollies, etc.

Personnel: John A. Clemens, Erwin G. Harwood.

Neumade Products Corp.
250 West 57 St., New York 19

Booth 46

Exhibiting: Motion-picture equipment for 16mm, 35mm and 70mm use including rewinding, splicing and editing components. Newly developed video tape storage and handling facilities will be premiered.

Personnel: L. E. Jones, R. E. Hempel, L. Grofsik, R. K. Riehn.

Precision Laboratories Booth 43
1037 Utica Ave., Brooklyn 3, N.Y.

Exhibiting: Precision Sound Readers for editing optical or magnetic soundtracks; unitized synchronizers; magnetic attachments for synchronizers; film slitters; editing devices for picture and sound.

Personnel: Irwin R. Sheldon.

Prestoseal Mfg. Corp. Booth 38
37-27 33 St., Long Island City 1, N.Y.

Exhibiting: Various sizes of equipment for motion-picture film as well as perforated paper tape and magnetic tape; butt-welding and overlap methods of splicing now available in new models of the Miracle Prestosplicer.

Personnel: Leonard A. Herzig, Sam Fliegelman, Alice Ryland.

11th annual convention and exhibits of the

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SEVENTY PAPERS: Studio and Speech Input Systems • Transistor in Audio Circuit Applications • Music and Electronics • Measurements and Standards in Audio • Disc Recording and Reproduction • Reverberation • Magnetic Recording and Reproduction • Stereo • Audio Applications • Loudspeakers • Symposium on Techniques in Production of Stereo Tape and Discs.

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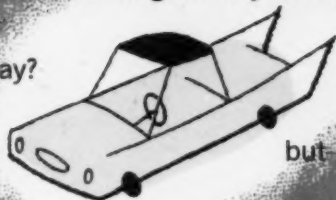
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Did you catch the commercial showing a driverless car driving blithely down

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It looked

but—you

guessed it—it wasn't.

A director of a well known producing company had this brainstorm. Terrific, but how do you do it? Our boys worked it out for him. Actually, CECO* experts and technicians are called upon to solve many more complex problems. Think of CECO as headquarters for the world's finest professional photographic

equipment—but think of us also when you're wrestling with a tough idea. Maybe we can help. Try us.

*CECO—Trademark of Camera Equipment CO

FRANK C. ZUCKER

CAMERA EQUIPMENT CO., INC.

Dept. 2 315 West 43rd St., New York 36, N. Y. JUdson 6-1420



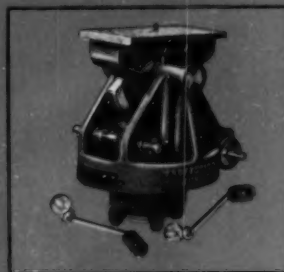
CECO Stop Motion Motor for Mauer Camera

110 volt synchronous motor. Can be operated single frame or continuous run on forward or reverse.

Exposure time: $\frac{3}{4}$ second at 170° opening; $\frac{5}{8}$ second at 235° opening. Attaches directly to Models 05 and 150. Stop motion motors available for most all other cameras.

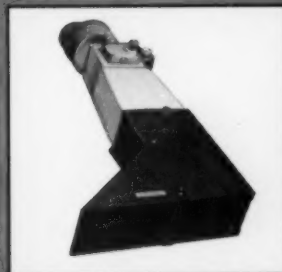
CECO Professional Junior Geared Head

Used for controlled pan and tilt. Smooth action. Ideal for Panoram shots and tabletop photography. Fits all Pro, Jr. tripod bases. Crank handles included.



Mozell Dual Image Viewfinder Attachment

Attaches to Mitchell or CECO Erect Image Viewfinder. Allows dual viewing of image scene by the cameraman and a director or account executive.



CECO Double Zipper Changing Bag

Lightproof; accommodates 1000' 35mm magazine or 1200' 16mm magazine. 34" x 48" black sateen outer bag. Rubber inner bag has roomy sleeves and light-tight wristlets.



Additional Products

CECO offers the world's largest and most comprehensive line of professional cameras, accessories, lighting, editing, processing and animation equipment including: MAURER Products (Exclusive Distributor); Oxberry Animation Equipment; Cooke Speed Panchro Series II, Kinetel, Kinoptic, and Bausch & Lomb Baltar Lenses. Other products we carry are: Color Charts - Computers - Splicers - Exposure meters - Projectors - Screens - Marking pencils and pens - editors gloves - stop watches.

Rentals

Cameras - 16mm and 35mm

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Lighting Equipment

Generators - Truck mounted or Portable

Sound Equipment

Projection Equipment

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CECO Triangles - Models R & C

Adjustable and collapsible. All aluminum construction. Brass studs for tripod points. Insures rigid positioning of tripod legs. Prevents slipping and damage to floors. (Model C illustrated). Model B without leg clamps.



CECO Underwater Housing for Eastman Kodak N-100 16mm Camera

Withstands water pressures at 75 ft. (with accessory pressure valve, down to 175 ft.) All camera controls easily operated under water. Viewing ports show film exposed, iris setting, spring wind. Constructed of 1/4" anodized dural plates. Accommodates 10 mm F1.8 fixed focus Angenieux Lens.



CECO Blimp for 16mm Maurer Camera

First contour model blimp for 16mm Maurer. Compact; permits easy accessibility to camera. Utilizes outside finder with follow-focus cam system.



ARRIFLEX 35, Model II B

Mirror reflex camera with direct, through-the-lens focusing and viewing, and three-lens turret. Features stronger hand grip motor to pull new 400' color magazine. Portable, rugged, dependable. The world's standard among cameramen.



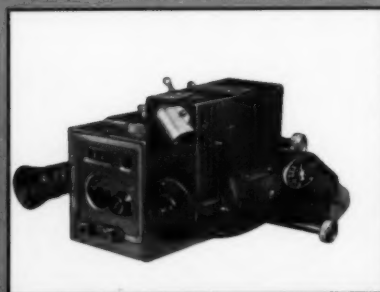
Ask about our Precision Repair and Design Engineering Service!

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CECO Variable Speed Motor for Maurer Camera

110 volt AC-DC operation. Equipped with tachometer. Motor drives camera at variable speeds from 8 to 48 FPS. Attaches easily to camera by 2 screws. Available in 12 volt DC.

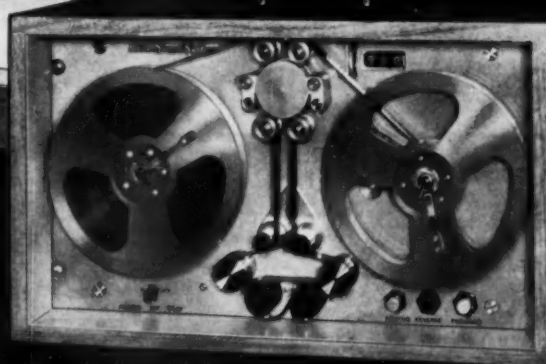
ANOTHER WAY
RCA SERVES
THROUGH
ELECTRONICS

NOW, FROM RCA...



The PA-151 Portable
Mixer-Amplifier

The PR-45 Portable
Magnetic Film Recorder



The first all-transistor PORTABLE RECORDING EQUIPMENT with electronic compression

For extreme portability, these units are highly compact and light in weight. But compact as they are, no sacrifice has been made in dependability, operating ease, or control convenience.

Both units are of rugged construction, and reflect the advanced electronics design which continues to make RCA the leader in the field.

An amazing number of ingenious features are included in these competitively priced units. The PA-151 and PR-45 are available for outright purchase, or may be leased.

Be sure to see these units in the RCA Booth at the SMPTE Convention, or write to either address below for complete information.



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Recording**

**RADIO CORPORATION
of AMERICA**

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Hollywood 38, Calif.
OLdfield 4-1660

411 Fifth Avenue
New York 16, New York
MUrray Hill 3-7611

Radio Corporation of America Booths 21, 22
Camden, N.J.

Exhibiting: Broadcast and closed-circuit TV equipment including RCA TV tape recorder Model TTR 1A; microphones; TV projector Type TP 6. Film recording equipment; PR-45 Portable Magnetic Recorder; PA-151 Portable Mixer Amplifier; MI 10002 Dialog Microphones; MI 10004 Microphone and Windscreen.

Personnel: P. Bergquist, Max Berry, Paul Greenmeyer, E. T. Griffith, L. W. Haeseler, A. F. Inglis, J. V. Leahy, Everett Miller, Dana Pratt, E. C. Tracy, Merrill A. Trainer, Neil Vander Dussen.

Rapid Film Technique, Inc. Booth 35
37-02 27 St., Long Island City 1, N. Y.

Exhibiting: Projection demonstration of film scratched and treated with Rapidweld for scratch removal.

Personnel: Jack Bernard, Sidney Dash, Jerome Gober, Henry Lloyd.

S.O.S. Cinema Supply Corp. Booth 23
602 West 52 St., New York 19
6331 Hollywood Blvd., Hollywood 28

Exhibiting: Tel-Animastand; Tel-Animaprint Hot Press; Tel-Amatic Printer; Tel-Amatic Film

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Maurice Levy (at right) and Sam Levy (at left) examining the S.O.S. TEL-Amatic Film Cleaning Machine, recently installed at Eastern Effects

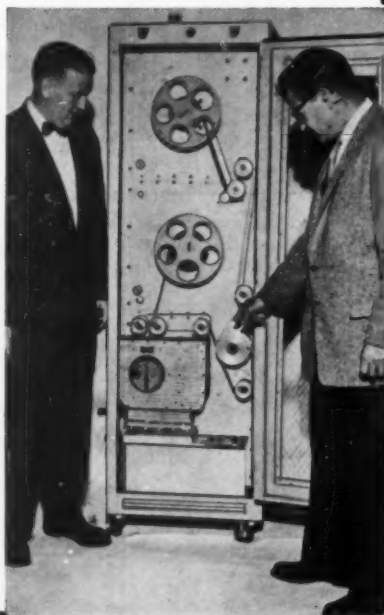
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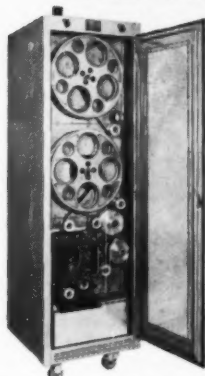
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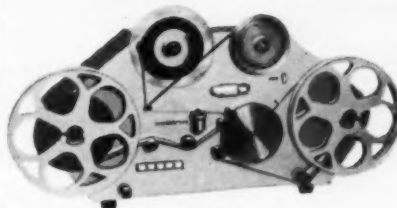
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In addition Soundstriper has rapid rewind footage counter, ball bearings, heated drying drum with built-in thermometer. Cinemaphon requires minimum maintenance since machine is self-contained.

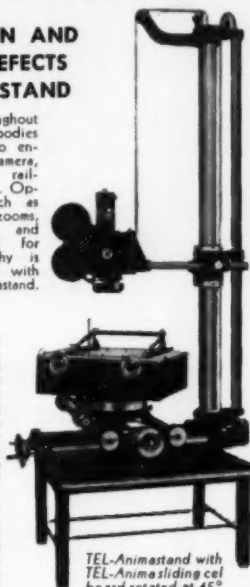
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Fifth International Congress on High-Speed Photography

Oct. 17-21, 1960, Sheraton Park Hotel, Washington, D.C.

Considerable progress has been made toward completion of plans for the Fifth International Congress since, in the August 1959 Journal (p. 550), preparations for the Congress were discussed and the background and significance explained. At present, general plans are nearing completion and even at this comparatively early date many delegates from countries other than the United States have made firm commitments. Congress officials and their areas of responsibility are:

D. Max Beard, Chairman, 10703 E. Nolcrest Dr., Silver Spring, Md.

Richard O. Painter, Associate Papers Chairman, General Motors Proving Ground, Milford, Mich.

J. S. Courtney-Pratt, Coordinator of Contributions from Abroad (obtained by national delegates), Room ID-449, Bell

Telephone Laboratories, Inc., Murray Hill, N.J.

Dr.-Ing. Hubert Schardin, Deputy Chairman (to assist in coordinating contributions from Europe), Rosenstrasse 10, Weil am Rhein, Germany.

James A. Mosses, Associate Chairman of Film Showings, 1202 Oberlin Dr., Bucknell Heights, Alexandria, Va.

The international importance of the Congress on all levels is made explicit by the impressive roster of delegates representing their various countries — men with world-wide reputations in the field of high-speed photograph and related areas of science whose names appear below:

W. D. Chesterman, Highfield House, Osmington Mills, Weymouth/Dorset, Great Britain

Dr. J. G. A. Graaf, Central Technical

Institute T.N.O., Koningskade 5, The Hague, Netherlands

Alexander Easson, Computing Devices of Canada, Ltd., P.O. Box 508, Ottawa 4, Ontario, Canada

Prof. Dr. J. Eggert, Photographisches Institut der Eidgenössischen Technischen Hochschule, Zurich, Sonneggstr. 5, Switzerland

Ing. Mil. en Chef de 1^{re} Cl. P. Fayolle, Laboratoire Central de l'Armement, Fort de Montrouge, Arcueil/Seine, France

Vaclav Kolar, Institute of Hydrodynamics, Solinova 7, Praha 6, Dejvice, Czechoslovakia

G. Nahmani, Ministry of Defence, Scientific Department, Hakiry, P.O.B. 7062, Tel-Aviv, Israel

Prof. Dr. P. Santorini, Université Technique Nationale, Laboratoire de Physique Experimentale II, P.O.B. 49, Athens, Greece

Prof. Dr.-Ing. H. Schardin, Weil am Rhein, Rosenstr. 10, Germany

F. Topfer, 24 rue des Guillemins, Liege, Belgium

A. I. Tschernij, Academy of Sciences, Leninchki prospect 14, Moskau, U.S.S.R.

A Resolution, S. Con. Res. 75, was introduced into the Senate on September 1 by Senator Warren Magnuson, for the Senate Committee on Interstate and Foreign Commerce, of which the operative part states: "Resolved by the Senate (the House of Representatives concurring): That it is the sense of the Congress that all interested agencies of the Federal Government should participate actively to the greatest practicable extent in the Fifth International Congress on High-Speed Photography, to be held in Washington, D.C., in October 1960 under the sponsorship of the Society of Motion Picture and Television Engineers." The full text of the Resolution will be published in the October Journal.

Education, Industry News

Weather in the Projection Room is the subject of a lecture by Frederick J. Kolb, Jr., to be delivered October 8 at 8 P.M. in the Hotel Times Square, New York, under the auspices of the Motion Picture Projectionists 25-30 Club, Inc. Dr. Kolb will also show a film entitled *Murder on the Screen*. Motion-picture film is cast as the "murderer" and the story is about the horrible things that can happen to film during its progress from manufacturer to screen with, of course, suggestions about proper handling to avoid this type of "murder." Following the lecture, Dr. Kolb will answer questions from the audience.

The 25-30 Club has also announced its 20th Anniversary Banquet to be held November 20 at the Hotel Empire, New York. Further information is available from Morris J. Rotker, 1258 College Ave., New York 56.

The Third International Biennale of Photography, Cinematography and Optics will be held in Paris in April 1961, it was announced by the Syndicat Général des Industries Photographiques et Cinématographiques Substandard, 94 Rue de Rennes, Paris 6, France. The first such meeting was held in Paris in 1955 and the second was held in Washington, D.C., in 1957.



Scratches on Film Irritate Audiences

Scratches are havens for dirt, and refract light improperly. On the screen, they mar the picture and may distract attention. If on the sound track, they produce offensive crackling.

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In addition to Studio filming, Auricon with Filmagnetic Sound is also being used for Television Newsreel programming of events happening all over the World. Noiseless operation is the best proof of precision design, and Auricon Cameras run so quietly that no cumbersome external sound-proof "blimp" enclosure is required! Producers and Cameramen from Hollywood to Hong Kong have named Auricon Cameras "Finest and Fastest-working 16mm Sound-Cameras!"

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RESULTS!"**

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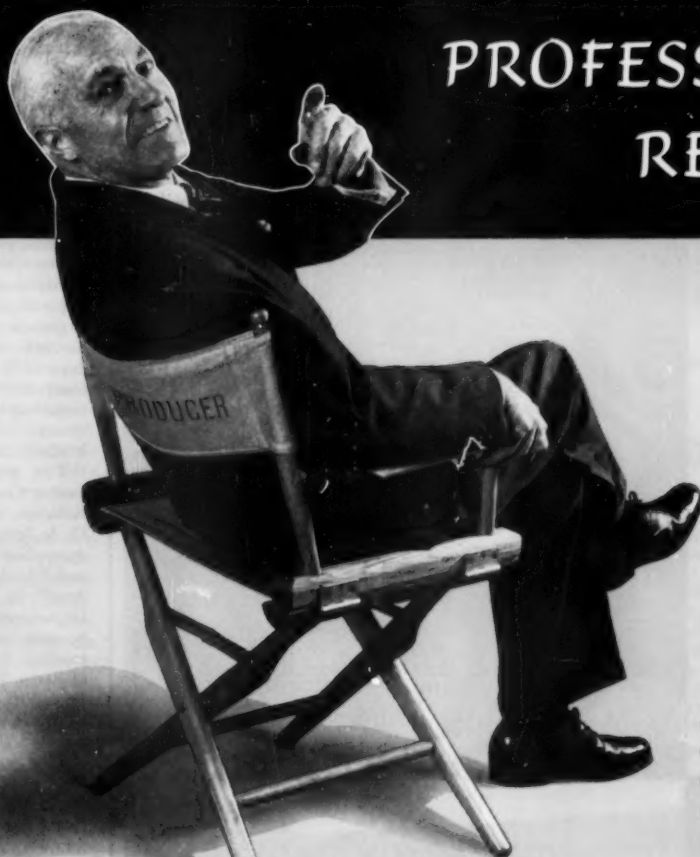
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Fifteen evening session courses in film making will be offered during the Fall term by City College's Institute of Film Techniques. The program includes classes in photography, screen writing, sound and film editing, directing and production. Elementary classes are open to amateurs without previous film training and advanced courses are provided for professionals. The Institute also offers Saturday workshop classes for advanced students who produce their own films. Classes are open to students without previous college background. Registration for evening session classes will be held September 16-17 at Shepard Hall, 139 St. and Convent Ave., 6 P.M. to 8 P.M.

The Inter-Society Color Council will hold its 29th Annual Meeting April 11-12, 1960, at the Philadelphia Museum College of Art, Philadelphia, Pa. A symposium on Creative Color will be held during the afternoon of April 12. Further information is available from Ralph M. Evans, Secretary, Inter-Society Color Council, c/o Color Technology Div., Bldg. 65, Eastman Kodak Co., Rochester 4, N. Y.

Newly elected officers of the Motion Picture Industry Credit Group of the National Assn. of Credit Management are: *Chairman*, Kern Moyse, Peerless Film Processing Corp.; *Vice-Chairman*, Walter Lynch,

Mecca Film Laboratories, Inc.; *Committee-Men*, Jack Fellers, Du-Art Film Labs., Inc.; Everett Miller, RCA Film Recording Studios; and Murray Kahn, Color Service Co., Inc. The Group, chartered April 1, 1953, with 18 members now numbers 30 of the leading motion-picture firms in metropolitan New York, Washington, D.C., and Chicago. Group Secretary is W. W. McAdam, NACM, 229 Fourth Ave., New York 3.

Construction of a new laboratory is planned by General Film Laboratory, Inc., 66 Sibley St., Detroit 26, as part of the firm's expansion program. A new 35mm negative/positive, spray-type processing machine will be installed in the new building and other equipment will be extensively modernized. Architect for the new construction is Theodore Rogvov and Barton-Malow Co. is general contractor. The addition to the laboratory is expected to be completed in August.

Progressive Architecture, 430 Park Ave., New York 22, devoted its May 1959 issue to a report on "Acoustics in Architecture," written and edited by Robert B. Newman of Bolt, Beranek and Newman, Acoustical Engineers. More than 30 illustrated and detailed case histories were selected to show solutions to typical acoustical problems. Beautifully illustrated, the report discusses general problems, special techniques and use of materials.

Visual Aids Review is a periodical published by the Dept. of Visual Aids, University of Melbourne. The October 1958 issue contains four articles of rather uneven quality and tone, plus a "New Books" section. The lead article, "Systematic Psychology and the Mass Media — Is There Any Connection?" seems more wordy than necessary. Its lengthy first sentence begins, "In view of the recondite abstruseness of the former field and the apparently incorrigible diffuseness of the latter..." Later in the article, the writer observes, "... The withers of earlier propounders of idiographic views on the continent... would be relatively unwrung by Walker's sallies... [etc.]."

Two articles, "The Australian Broadcasting Control Board and Its Functions in Relation to Television Programmes," by D. A. Jose, Director, Programme Services, Australian Broadcasting Control Board, and "Australia Moves Into the Television Area" by Newman Rosenthal, Director, Department of Visual Aids, Univ. of Melbourne, are informative and well worth reading. The fourth article, "Some Results of Eight Yearly Studies of Television" by Paul Witty of Northwestern University is a study of the TV-viewing habits of American children. The magazine as a whole is stimulating and presents a fresh and interesting viewpoint.

Notes on Tropical Photography published by Eastman Kodak Co. is a revision of an earlier booklet and includes a new section on prevention and removal of fungus growth on processed photographic film. The 36-page illustrated booklet offers details and practical advice that would be equally helpful to photographers

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The Process Master's outstanding versatility marks it as the most significant achievement in quality 16mm processor design. With one Process Master and accessories, any laboratory is able to process Kodachrome, Moviechrome, 5269, 7255, Anscochrome and B&W. Constructed with type 316 stainless tanks for high corrosion resistance, the Process Master delivers accurately controlled processing with a minimum of supervision and maintenance. Clearly a profit-maker for any lab, this flexible fully automated unit is attractively priced. Write on company letterhead for literature.



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resident in tropical countries and for tourists. Sections include detailed discussion of Materials and Equipment, Exposure, Processing, Storage of Processed Film, and Preservation of Black-and-White Films in the Tropics. The booklet is available without charge from Sales Service Division, Eastman Kodak Co., 343 State St., Rochester 4, N. Y.

The first of two experimental 45-min color films on biology was made during a three-day conference at Cold Spring Harbor, L.I., N.Y. by the University of Houston's KUHT Film Production Unit under a grant from the National Science Foundation. Subject of the conference was "Speciation," the process by which species are formed and variations become fixed. The second film will be on the subject of "Meiosis." It is planned as a documentary-type film and will employ considerable photomicrography.

Children and Television is an annotated bibliography assembled by Dale B. Harris, Director, Institute of Child Development and Welfare, University of Minnesota, for the National Assn. of Educational Broadcasters, 14 Gregory Hall, Urbana, Ill. The 50-page booklet contains brief descriptions of the contents of articles on the general subject of the effect of television on children. The Contents includes: Surveys and Studies; General Approaches; Educational Outcomes of TV for Children; Discussions for Parents; General Comments and Opinions on Children's TV Programs; Reviews, etc.; Principles and Recommendations Concerning Programs for Children.

A Conference on Radio Interference Reduction and Electronic Compatibility will be held Oct. 6-8 at the Museum of Science and Industry, Chicago, under the sponsorship of the Army Signal Research and Development Laboratories. It will be conducted by Armour Research Foundation of Illinois Institute of Technology in cooperation with the IRE Professional Group on Radio Frequency Interference. Discussions will center around research aimed at suppression of electromagnetic interference with the functioning of electronic equipment.

Ninety-seven engineers were awarded Masters Degrees June 10 upon completion of an advanced study program inaugurated two years ago by Bell Telephone Laboratories in cooperation with New York University. Classes are conducted at the NYU-Bell Laboratories graduate center in Murray Hill, N.J. The center is staffed by faculty members from the NYU College of Engineering and financed entirely by the Laboratories. Students in the program receive full salary from the Laboratories while studying and working part-time in the technical departments. Courses are designed to develop a strong background for engineers embarking on careers in creative work in the field of communications.

The National Association of Educational Broadcasters has received the sum of \$42,738 from the W. K. Kellogg Founda-

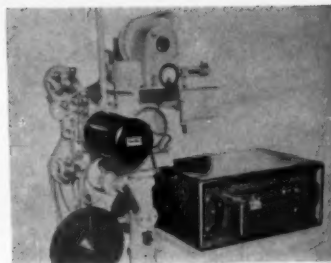
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tion as the first payment of a three-year grant totaling \$106,338. Harry J. Skornia, Executive Director, has reported that the grant would enable the NAEB to conduct seminars for advance training of personnel within the fields of educational radio and television. Plans also include appointing a full-time editor for the organization's various publications.

A closed-circuit TV auction sale of U.S. Government surplus property will be held October 7 at six viewing locations where prospective purchasers may inspect and bid for items with an estimated total value of \$1.5 million. The system will be set up by TelePrompTer Corp., 311 W. 43 St.,

New York. Large TV screens will be installed in 103d Armory, Philadelphia; National Guard Armory, Columbus, Ohio; Manhattan Center, New York; American Theatre, St. Louis; Commonwealth Auditorium, Boston; and the Coliseum, Chicago. Each location will accommodate an estimated 1500 persons.

Closed-circuit television production was discussed at a seminar at Pennsylvania State Univ., August 25-28, conducted by National Assn. of Educational Broadcasters. Topics discussed included teacher-producer relationship, and technical problems of sets, lighting, make-up and use of equipment. Special consultants were Rudy

Bretz, Univ. of Calif., Los Angeles; Miss Rhea Sikes, Station WQED, Pittsburgh; and Robert Rippen of Continental Classroom.

The teacher-training program conducted by the English Language Institute of the University of Michigan for teachers planning to teach English to foreign students has been expanded and improved by the use of closed-circuit TV. Under the Institutes training program, the student teachers are enabled to watch on television the classroom methods of an Institute instructor as he teaches foreign students. The TV system is financed by the Ford Foundation and camera equipment is supplied by the Radio Corp. of America.

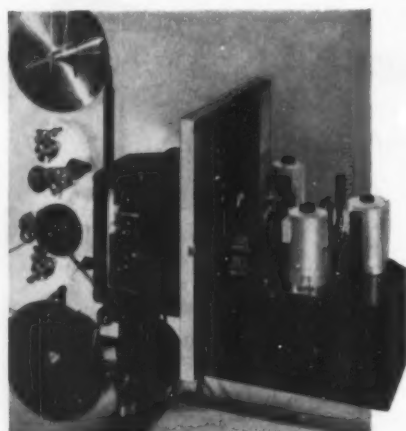
A course in Modern Chemistry to be presented in color over the NBC network as part of Continental Classroom has been announced. The course will be conducted by John W. Baxter, of the Univ. of Florida, 6:30 to 7 A.M., Monday through Friday. The American Chemical Society and the American Assn. of Colleges for Teacher Education will be co-partners with NBC in the presentation. The course in Atomic Age Physics presented last year will be repeated from 6 to 6:30 A.M. Financial support for the Modern Chemistry course is contributed by Ford Foundation and nine industrial firms, including RCA, which has announced its contribution as \$100,000.

Eduardo More has accepted appointment on the SMPTE Papers Committee as National Regional Chairman for Cuba. In his letter acknowledging confirmation of the appointment, Mr. More said "... in Cuba there are very enthusiastic members of the Society ... (and) we are trying to increase the membership."

Joseph L. Boon, associate director of apparatus research and development for the Apparatus and Optical Div. of Eastman Kodak Co., has been appointed administrative assistant to the general manager of the company. In his new position he will maintain liaison with certain classified military projects in which the company is engaged. He also will coordinate several programs in such fields as microfilming, document copying, photofinishing and new processing techniques. He has been with the company since 1929.

Robert E. Lewis has joined Beckman & Whitley, Inc., as a senior optical engineer on the development of optical systems for high-speed instrumentation. Prior to his present appointment he was with Bausch & Lomb Optical Co. where he has recently been engaged with fiber optics research. He has also been a member of the field engineering group of the Chicago Midway Laboratories of the Univ. of Chicago, located at Eglin Air Force Base, Fla., where he was concerned with the optics and photography of range instrumentation.

Rudy Bretz has been appointed Head of Educational Television for the Univ. of Calif. in the southern area. He has been a member of the Theater Arts faculty at the



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High efficiency interference-type dichroic beam splitters to form a single mixed output beam.

Colored glass and/or high efficiency interference-type trimming filters, "peaked" to the positive stock sensitivity.

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Three 750-Watt bulbs, operating at 60-80 volts. Assures long bulb life, saving time in calibration.

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Four-leaf adjustable diaphragm, imaged at the printing aperture which provides an optical printing aperture for exposure and/or uniformity control (on units to fit Bell & Howell Models D & J only).

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Keyboard and Punch with 32 combinations for each color; blue, green, red; with an additional channel for introducing other information such as stop, lap dissolves, etc., and with built-in scene counter. Can also be used with Reader to reproduce automatically duplicate tapes and will permit corrections of the tape and continue with the accepted information. Price: \$2,100 F.O.B. New Rochelle, N. Y.

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A-5135 for 35MM film

A-5100 for combination 16 and 35MM film (permitting one size to follow the other immediately)

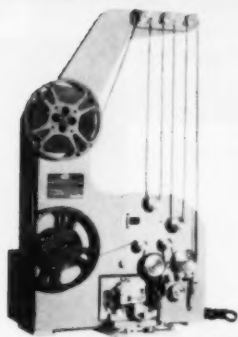
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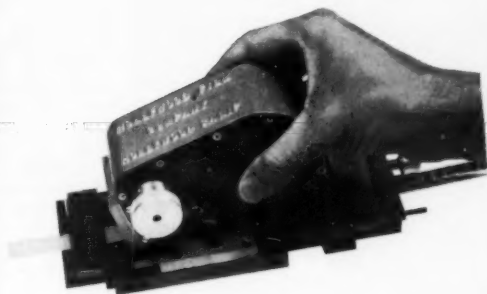
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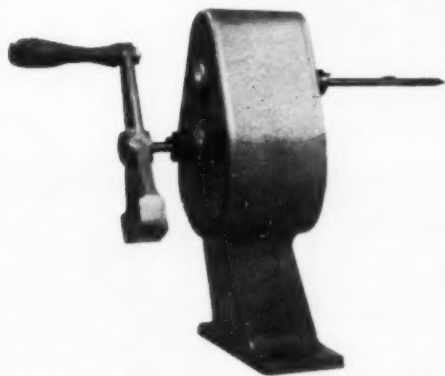
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Univ. of Calif. Los Angeles since 1956. Responsibilities of the new appointment include the development of educational TV programs under the administrative direction of the Associate Director of University Extension, keeping faculty members informed of new developments in the field and providing technical consultation in the development of educational television at the University. Filming of two courses to be presented on television is now underway, one by single-system and the other by double-system sound, each utilizing the Auricon camera. One is an advanced mathematics course for engineering stu-

dents and the second is a basic series in space technology.

Arthur Miller has been elected Vice-President and General Manager of Du Art Film Laboratories, Inc., and Tri Art Color Corp., motion-picture film processors. A veteran of 40 years in the film industry, he was formerly Vice-President and East Coast Manager of Pathe Laboratories, and prior to that Vice-President of Republic Pictures and General Manager of the Consolidated Film Industries plant at Fort Lee, N.J. Mr. Miller is Chairman of the Get-Together Luncheon of the Society's 86th Convention.

Obituaries



George L. Carrington, Sr.

George Carrington, Chairman of the Board of Altec Companies, Inc., and Vice-Chairman of the Board of Ling Electronics, Inc., died June 19 at the age of 57. Born in Little Rock, Ark., he received his training in engineering at Tulane University. He began his lifetime career in the electronic and audio industries with the Bell Telephone Co. In the early twenties, Mr. Carrington designed and supervised construction of two radio stations, WDSU in New Orleans and KVOO in Tulsa, Okla. In 1928 he was employed by Electrical Research Products, Inc., to supervise the installation of the earliest motion-picture theater sound equipment. In 1937, together with L. W. Conrow, he formed the Altec Service Corp. of New York. In 1941, when the company purchased Lansing Mfg. Co. of Los Angeles, he became President and Chairman of Altec Lansing Corp., and in January of this year, he became Vice-Chairman of the Board of Ling Electronics, following the merger with Altec. A member of the Society, other organizations with which he was affiliated include the Motion Picture Pioneers, Academy of Motion Picture Arts and Sciences, and Acoustical Society of America.



William G. Stuber

One of the foremost pioneers in photography, William G. Stuber died June 17 at the age of 95. Successor (1925) to George Eastman, founder of Eastman Kodak Co., as the company's President, at the time of his death he was Honorary Chairman of the Board of Directors, a title accorded

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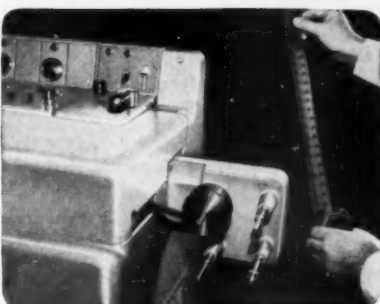
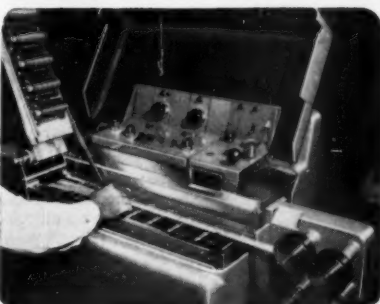
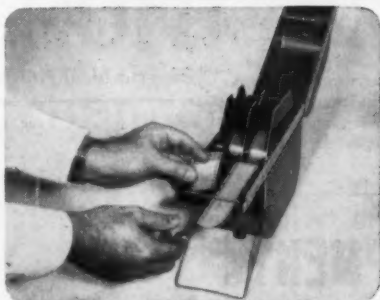
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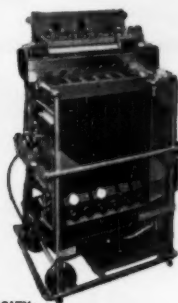
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him at the time of his retirement in 1941. In 1934 he was elected Chairman of the Board of Directors, serving in that capacity until his retirement. He joined Kodak in 1894 as an expert in photographic emulsions at the invitation of George Eastman, whose successor he later became.

He was born in Louisville, Ky., in 1864, the son of one of the first professional photographers in Kentucky. At the age of 17, following the death of his father, he took over the business. His main concern was to develop a better photographic emulsion. His early struggles are touchingly revealed in a biography written by his wife, Rose, who died in 1947. "Quest of the perfect emulsion was Stuber's sole pur-

pose after livelihood was provided," she said, "and livelihood was meager... It was vital to mix and stir emulsion continuously in a darkened room... man and wife alternated their sleeping hours... and so on, night after night." This "stubborn sacrifice," as she called it, eventually resulted in tangible rewards. In 1889, Mr. Stuber was awarded two bronze medals by the American Society of Photographers, and the following year the organization elected him its Vice-President. Four years later the invitation from George Eastman came offering him an appointment as head of the emulsion-making department at Kodak Park Works in Rochester.

During his 47 years of active service with

Eastman, under his direction improved photographic emulsions were introduced; a way to manufacture film continuously on a revolving wheel was placed in operation; the first motion-picture film was manufactured and, shortly after x-rays were discovered, Kodak photo products were modified for use in x-ray work, among other milestones recorded during his management.

Biographical Notes



Robert S. Burnap

Robert S. Burnap, pioneer electron tube engineer, has retired as Manager of Commercial Engineering, RCA Electron Tube Division, after 42 years with RCA and predecessor companies. He will continue to serve the Division as a consultant.

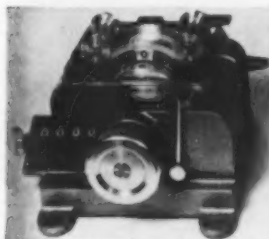
Born in Monterey, Mass., Mr. Burnap was graduated from the Massachusetts Institute of Technology in 1916 and remained there as a research assistant in Illumination and Photometry for a year following his graduation. In 1917 he began his career as an engineer with the Edison Lamp Works of the General Electric Co. and was placed in charge of the Physics Laboratory. During World War I, he was a master signal electrician with the Testing Section, Research Laboratory of the Signal Corps. After his military service he returned to Edison Lamp Works where he engaged in engineering and lamp design and, in 1924, was appointed Manager of the Commercial Engineering Section of the Lamp Works. In 1930, when the plant was acquired by RCA, he remained in the same position.

Mr. Burnap holds a number of patents on lamp design. He has been active on many professional society and industry standardization committees. A Fellow of the Society since 1934, he also holds the rank of Fellow in the IRE and the AIEE.

A. H. S. Craeybeckx, lecturer and author, celebrated on May 1, 1959, his 35th year with Gevaert Photo-Production where he holds the post of Chief Editor. Among his publications are *Gevaert Manual of Photography*, published in 13 languages, and *Photorama*, the international review of photography. A lecture delivered in 1956 before UNESCO on the subject of "Photography as a Language," received international notice. He is also Chief Editor for Belgium of the Dutch publication, *Elseviers Encyclopedia for Photography and Cinematography*.

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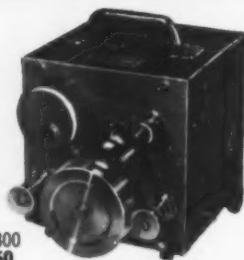


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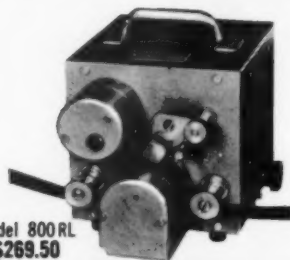


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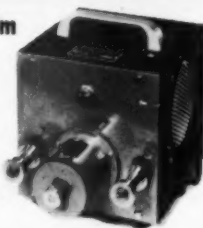
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Anhydrous Sodium Thiosulphate	PH4.250-1953	Sodium Acetate, Anhydrous Granular	PH4.176-1958
Benzotriazole, Photographic Grade	PH4.204-1955	Sodium Bisulfite, Photo Powdered	Z38.8.276-1949
Benzyl Alcohol	PH4.181-1954	Sodium Bromide, U. S. P. Granular	PH4.207-1954
Borax, Photo Granular	PH4.230-1954	Sodium Carbonate, Mono- hydrate	PH4.227-1954
Boric Acid, Photo Granular	Z38.8.103-1949	Sodium Hydroxide, N. F. Pellets	PH4.225-1956
Citric Acid, U. S. P. Granular	Z38.8.102-1949	Sodium Metaborate, Octa- hydrate	PH4.231-1954
Formaldehyde, N. F. Solution 37%	Z38.8.152-1949	Sodium Sulfate, Anhydrous	Z38.8.175-1949
Graphol (Metol)	PH4.125-1956	Sodium Sulfite, Anhydrous Photo	PH4.275-1952
Hydroquinone	PH4.126-1955	Sodium Thiocyanate, N. F. Crystals	PH4.177-1956
Potassium Alum, U. S. P. Granular	Z38.8.150-1949	Sodium Thiosulphate, Rice Crystals	PH4.251-1953
Potassium Bichromate, Photo Granular	PH4.300-1958		
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Video Tape Reports From Miami Beach Convention

New Horizons for Television Tape

By ROSS H. SNYDER

The initial applications of television tape to network delay and commercial inserts suggested to a number of producers that eventually magnetic tape combined with electronic techniques would supplement and perhaps replace somewhat the photographic film used in production and for TV release. Prospects for such an eventuality depend upon technical and economic considerations. Television tape has demonstrated capabilities and limitations and there are suggested future possibilities, including some non-television applications.

Magnetic-tape recording has been in commercial use for almost three years. Regularly scheduled use of magnetic TV tape was inaugurated in November 1956, when the CBS TV network rebroadcast to its Pacific Coast network the program *Douglas Edwards With the News*. By April 1957, the three major networks were using magnetic tape for regular local clock-time delay and in December 1957, the first production Videotape* Recorder was de-

livered to KING-TV in Seattle. In April 1958, a demonstration of color recording was given before the national convention of the NAB.

Soon, with production Videotape Recorders in operation, tapes were being exchanged among stations and being re-played interchangeably. By midsummer of 1958, TV tape recorders were installed by three non-broadcasting firms for production of programs or commercials. In the fall of 1958, TV tape's ability to be spliced was exploited when CBS produced "The Old Man" for *Playhouse 90* by making 112 takes on separate shots and splicing 55 of them into a successful 90-minute dramatic program. Besides the usual television arts, the new facilities of the magnetic tape process were employed.

Adaptation of certain film techniques and effects to fit the needs of television programmers has been successfully accomplished. For example, NBC synchronized several sound tracks on separate magnetic sound playback machines with a tape-recorded TV picture for the *Bob Hope Show*.

Lap Dissolves

Another film effect which has been adapted to TV cameras and tape is the time-sequence lap dissolve. A cosmetic commercial employing this effect was demonstrated in January 1959, by Videotape Productions of New York. Appearing as if

on live television, the girl in the commercial appeared before, during and after using the sponsor's product, lap-dissolving from sequence to sequence.

This lap-dissolve sequence did not involve the use of new or special tape-synchronizing devices. The model was first recorded in the opening sequence as she applied the cosmetic, and a portion of black picture was recorded following the sequence. When the model was ready for the final sequence, a portion of black was recorded on the tape before the camera was opened to record the model as she appeared after application of the cosmetic. The sections of black after the first sequence and before the third sequence were spliced together so that the amount of black which intervened between the first and the third sequence was of exactly the length desired for the middle sequence, in which the model would be shown applying the cosmetic. The tape was then set for playback on one machine while the model stood by with the live camera in the studio. The tape was then run and a copy made on a second machine. Toward the end of the first sequence, with the camera locked to sync from the tape recorder, the feed to the second recorder was lap-dissolved by means of a conventional studio mixer from tape-playback to live camera. The carefully timed middle sequence was recorded on the second recorder from the live camera. Toward the end of this sequence, a second lap-dissolve was executed from live camera to tape. The whole sequence was thus recorded on the second recorder. The sequence with the model before she applied the cosmetic lap-dissolved to the sequence showing her applying the cosmetic, which lap-dissolved into the "after using" sequence.

Copies of the tape were then made for distribution. In the copies which were released the first and third sequences were copies of copies and the second was a copy from an original tape.

The Cue Track

Three new facilities have recently been made available for attachment to earlier Videotape Recorders. The first is a cue track. Recorded on a 20-mil longitudinal track, located between the control-track and the lateral television tracks, this track is used for voice instructions recorded at the time of the original taping, or, later, for directing the editing and other processing of the recording, or for automatic code signals. Tones originally recorded at frequencies in the 400-cycle region can easily be reproduced, even at rewind or fast-forward tape speeds, therefore series of tone bursts can be recorded on this track, for later control of the recorder. For example, four bursts might indicate rewind, three bursts fast-forward, and two stop, so as to provide an automatic rewind and cue sequence. The cue-track has its own erase head, located in the audio erase stack, and its own record/reproduce head, on the audio record/playback stack. Information recorded on the cue-track cannot be accidentally mixed with the recorded high-quality audio.

The second of these new facilities is the automatic two-inch erase head, which is placed in operation whenever the video recording circuitry is engaged, thus insuring

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against accidental failure to erase a whole reel of tape before recording, and against the possibility of recording over a previous recording, thus losing both recordings. In production with tape there is no need to preserve bad "takes," which are usually immediately reviewed on the set for the benefit of the performers. The tape machine may be rewound to a point before the beginning of the rejected take, and the sequence started over again, erasing the old "take" as the new one is recorded. Thus, a reel of recorded tape can be collected, which contains only acceptable takes.

The third of these new facilities is the tape timer. Located to the right of the video heads on the recorder transport mechanism, this device reads directly in hours, minutes and seconds. It is accurate to five seconds in a full hour of recorded tape, giving the director continuous information concerning the cumulative time of his recording. It serves also as a device for locating quickly the exact point, inside a recorded tape, where a given sequence, logged in advance, is to be found.

Magnetic tape has given memory to live television, without imposing any limitation on the facilities live television already had. The special facilities possessed by live television are, of course, shared by live television on tape. One of these is the extraordinary effective "emulsion speed" of the image-orthicon camera. When a magnetic tape recorder is attached to a TV camera, we have in effect a faithful live-TV memory with an ASA speed of 2500 or more. This, by itself, gives the director the opportunity to shoot pictures under lighting conditions which would not be acceptable for photography, and gives him also the familiar advantages of high-speed emulsions in control over depth-of-focus.

Special Effects

The bag of tricks which is familiar to the live television producer is now open wide for the use of the syndicated TV program producer. A TV special-effects generator, like the one recently shown by Telechrome, is not only capable of a wide variety of montage and split-screen effects, wipes and fades and lap-dissolves, but is also capable of instantaneous electronic matting and superimposition, both moving and still. The special effects generator can distinguish, either on the basis of brightness or, in special applications, on the basis of color, between sections of picture. Thus, a brightly-lighted actor on one set can be electronically matted into a completely different background; titles of any degree of movement or complexity can be electronically matted into previously-shot sequences; puppets or other moving models can be superimposed into live scenes, without laborious artwork. And, through the use of a magnetic TV tape recorder, all these effects can be performed in a series of steps, separated by any time-period which may be desired. New electronic skills are being developed, which extend the capabilities of live television.

There are applications outside TV entertainment for which the magnetic TV tape recorder opens new horizons. Yonkers Raceway in New York is using TV cameras and a tape recorder to monitor every event

during its horse-racing schedule. Questions over happenings during any race may be officially decided immediately after the race by review of the tape, and official decisions released immediately. Through this facility Yonkers has been able to add one more event daily to its operating schedule.

In scientific and military research it is often desirable to observe, and also to preserve a visual record of, events which cannot be survived by human observers or film cameras. Events inside highly radioactive areas are commonly watched by TV cameras, whose output may conveniently be recorded on a tape recorder.

Color Programming

Color tape is of great importance in the future, in non-television broadcasting. The color television camera is the most accurate color-measuring instrument yet devised, and by suitable auxiliary instrumentation may be used with a color TV tape recorder to preserve indefinitely a precision record of events where brightness, hue and chroma are of special scientific or military importance. It has been shown that the NTSC color system not only possesses greater accuracy in color metering, but also possesses a greater range of hue and chroma representation than does any photographic color process.

It may safely be predicted that the use of magnetic TV tape will increase in the months and years ahead, supplementing photography, and to some extent supplanting it in entertainment television and in scientific, military and industrial uses. Nowhere is this more evident than in the prospect of the wider use of color. The color TV tape recorder uses exactly the same tape as its monochrome counterpart—no special color tape is used. Color tape is also replayable almost immediately—as soon as it can be rewound. It is capable of interchange, splicing and duplication. Color TV uses the same electronic special effects devices and electronic editing techniques as monochrome TV. Insofar as color is in the future of television, it may be predicted that color tape will be the popular medium, because of superior broadcast quality and also because of economic consideration.

The Ampex Videotape* Recorder and Its Performance on Foreign TV Standards

By KURT R. MACHEIN

The problem of adapting the Ampex Videotape Recorder to foreign television standards is discussed and the solution outlined. This recorder is adaptable to all television standards, while vital mechanical components such as video head, capstan, tape, etc., remain standard parts.

Following the introduction of the Videotape Recorder in the United States it became apparent that the possibility of its adaptation to other than the U. S. Federal Com-

Condensed from a paper presented on May 8, 1959, at the Society's Convention at Miami Beach by Kurt R. Machein, Ampex Export Sales Co., 934 Charter St., Redwood City, Calif.

* Trademark of Ampex Corp.

munications Commission television standards should be seriously examined.

With three other television standards in current use, modification to other than FCC standards involved a variety of problems. Any conversion requiring deviation of components construction would place the burden upon multiple engineering and manufacturing efforts, and would certainly result in considerable increase in price and in service requirements; therefore, the question of maintaining standard parts on modified Videotape Recorders became of vital importance. In regard to tape speed and video-head speed, however, we were by no means restricted to any specifications and we felt that we could therefore deviate within reasonable limits to meet some of the new requirements.

By analyzing the problems of the modification, for instance from FCC standards to British standards, it was found that the following deviation in specifications represented the major factors:

Deviation in power line frequency from 60- to 50-cycle, in frame rate from 30 to 25 frames/sec, in horizontal resolution from 525 to 405 lines, plus the differences in specifications of the composite video signal itself, such as horizontal sync width, horizontal and vertical blanking, equalizing pulses, etc.

Since the reproduction of the television signal from tape requires a very high stability of the rotating video head in respect to station synchronizing pulses, the head motor is normally locked electronically to incoming station sync by means of a servo system, which also controls the speed of the tape in longitudinal direction to maintain accurate tracking of the video head during playback operation. For practical reasons, then, the video head speed is chosen to be an even multiple of the vertical sync frequency, while the capstan speed is controlled by a frequency which is an even fraction of the head speed. Since on the British TV standard this reference frequency for the servo system is 50-cycle compared to 60-cycle on FCC standards, we had the option of using either 200 rps or 250 rps as video head speed compared to 240 rps on FCC standards. In regard to actual speed between video head and tape and its importance in respect to high-frequency recording, the 250 rps was obviously more suitable. To maintain the standard spacing between video tracks on the tape, it was essential to increase the longitudinal tape speed from 15 in./sec to 15.6 in./sec. The increase in video head speed necessitated also a change of control frequencies used in the correction network for the rotating video head based on a phase comparison principle. This frequency was changed from 60- to 250-cycle, which resulted in an increase in correction of video head speed and positioning by approximately a factor of four.

In this particular case, the modification of the Videotape Recorder seemed to improve slightly the overall performance of the unit compared with its standard version; at least the modification certainly did not result in a deterioration of the performance.

Other electronics connected in operation with the composite video signal or its direct derivatives consequently required alteration, but not beyond simple components changes.

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Fig. 1. Demonstration setup for interswitch operation on two television standards

The modification from FCC to CCIR standards was in some respects more critical, especially in regard to the necessary increase in bandwidth from 4 mc to 5 mc.

To record the frequency-modulated 5-mc video signal, it was mandatory to increase the standard carrier frequency of 4.75 mc to at least beyond 5 mc, in consideration of an effective separation between carrier and video information. To avoid interference pattern on the playback picture, the carrier frequency was increased from 4.75 to 5.5 mc.

The standard Videotape Recorder is capable of reproducing 4-mc video com-

ponents approximately down 10 db in relation to the 100-kc level, which represents a nominal 4-mc bandwidth and is adequate for FCC and British standard operation. CCIR standards, however, require a 5-mc bandwidth if noticeable deterioration of the picture quality, especially in terms of vertical resolution, is to be avoided. To increase the overall frequency response of the Videotape Recorder, it was necessary to improve the rise time of the multivibrator in the modulator unit considerably, which in essence results in an improved frequency response of better than ± 3 db from 15 kc to 4 mc and down not more than 10 db at

5.5 mc, as compared to standard specifications of ± 3 db from 15 kc to 2.5 mc and down no more than 10 db at 4 mc.

The signal-to-noise ratio of better than 30 db pp signal to rms noise had also to be maintained if not improved. The increase in carrier frequency as well as the increase in deviation of the carrier, now up to more than 8 mc, consequently had to be accompanied by simultaneous improvements on the video head performance.

The first VR-1000 modified to operate on CCIR standards incorporating the change to 5-mc bandwidth was delivered to ATN-TV in Sydney, Australia, and performs very well within CCIR specifications with a signal-to-noise ratio of better than 33 db.

A conversion of the Videotape Recorder to operate satisfactorily on the French television standard was, at first, considered impractical because of its bandwidth and its horizontal resolution of 819 lines. The recent improvements in the bandwidth and the proven adaptability of the Videotape Recorder to foreign standards, however, initiated a new approach to this problem with a result that, after termination of laboratory tests in Redwood City, the first modified Videotape Recorder is performing satisfactorily even on French television standards. Overall frequency response even beyond the 5-mc range required a further increase in speed of the rotating video head to 300 rps; but it is still intended to maintain the longitudinal tape speed of 15 in./sec, which in essence preserves the recorder's ability to accommodate a one-hour program on a standard size reel.

With Videotape Recorders operating on all four standards all over the world, the exchange of live TV recordings between countries operating on different standards will be the next logical step. To make this exchange possible, Ampex has developed the "inter-switch" modification.

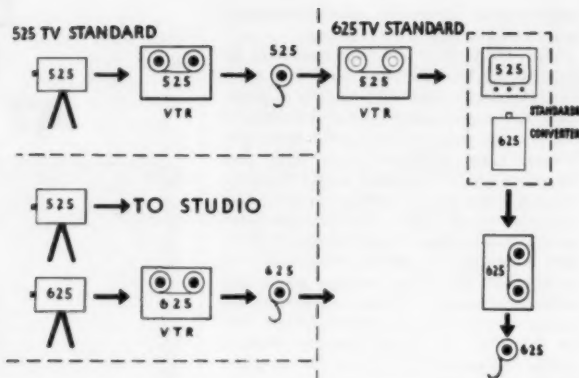


Fig. 2. Interswitch modification used in program exchange. Either one of two methods may be used.



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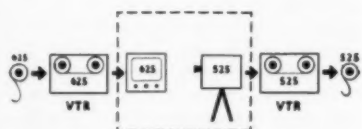


Fig. 3. Interswitch video tape recorder used for standard conversion.

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An otherwise standard Videotape Recorder with a prototype inter-switch modification was demonstrated to CCIR delegates at Los Angeles at the Ninth Plenary Assembly of the International Radio Consultative Committee (CCIR), recording to either the 525-line, 60-field TV standard used in the United States, Canada, Japan, Mexico and some South American countries; or the 625-line, 50-field standard used in most of Europe, in Australia and elsewhere. Changeover between standards on the prototype inter-switch Videotape Recorder was accomplished by throwing a single switch mounted on one of the recorder's two electronics racks.

During the demonstration, recordings to both the 525-line and 625-line standards were made, using a Marconi Mark III camera chain with 4½-in. image-orthicon tube, also switchable between the two standards, and both Rank Cintel and Marconi 625-line monitors as well as Conrac 525-line monitors. Recordings made on 625-lines on the demonstration VR-1000 could be played back on any other Videotape Recorder built to the 625-line, 50-field standard, while the 525-line recordings are fully compatible with every Ampex Videotape Recorder in the Western Hemisphere and Japan.

An Advertising Agency's Experience With Video Tape

By ALEXANDER CANTWELL

The experience of a large advertising agency in the use of video tape is outlined and examples given. Beginning in the fall of 1958, the firm of Batten, Barton, Durstine & Osborn, Inc., has been using video-tape recording in various ways for most of its major TV accounts, with many resulting advantages and some disadvantages.

In September 1958, the advertising firm of Batten, Barton, Durstine & Osborn, Inc. (BBDO) was using tape for many of its commercials and had plans for replacing virtually all its live commercials with tape. By May 1959, the use of the live commercial for a network show had been virtually abandoned except for "personality" shows where the commercial is based upon identification with a prominent personality.

It is a little early to answer with a firm "yes" or "no" the question, "Will tape ever replace film?"—but certain trends can be observed and some predictions made. During the month of April 1959, a significant number of BBDO's clients changed from film to tape for commercials. A typical case is that of Armstrong Cork Co. which, on March 31, taped three commercials for the Armstrong Circle Theater. This firm formerly used live commercials almost exclusively but early in 1958 the firm decided to make a substantial number of filmed commercials. Before the film project was completed it became possible to repeat taped commercials and the firm switched the balance of the year's scheduled commercials to tape. At present it has no plans for

Condensed from a paper presented on May 8, 1959, at the Society's Convention at Miami Beach by Alexander Cantwell of Batten, Barton, Durstine & Osborn, Inc., 383 Madison Ave., New York 17.

using film. Another firm that has turned to tape is General Electric and a number of similar cases could be cited.

On April 13, BBDO for the first time used a film company for a taped commercial. Five commercials for Du Pont Fibers were produced at Elliot, Unger & Elliot, a subsidiary of Columbia Pictures. In the opinion of the author, the trend to tape is obvious, but when or if tape will completely replace film in the production of commercials can hardly be predicted.

Program Use of Video Tape

The most frequent program use of video tape is for dramatic inserts. Without the use of tape, a costume change or an abrupt scene change had to be taken into consideration. Dramatic scenes involving quick changes can now be prerecorded and the taped scene dropped into an otherwise live television program. Also, the scene can be taped the day of the broadcast and used later that same day. Similarly, in a live program, location exteriors can be made on tape and dropped into a studio-originated program, without noticeable loss of quality. Difficult scenes involving special effects can be pretaped for assurance that the special effects will work on the air. On many of our specials the program itself has been taped in advance for a variety of reasons.

A Du Pont show of the month, a 90-minute version of *Hamlet*, is a good example of the use of editing techniques now possible with tape. This show was shot out-of-sequence, and assembled later from 75 pieces of tape. With the present editing equipment and under controlled conditions it is now possible to edit from picture to picture. It should be noted that great improvements are being made in editing equipment. *Hamlet* utilized the best of both film and live techniques and it was an historic program in the development of video tape.

Tape for Commercials

The most significant use of video tape from an agency's standpoint is for commercials. It is particularly useful for commercials in "specials." In a spectacular show the commercial must be spectacular too. The type of production used for Shaeffer Pen, Westclox, Philco and Rexall, for example, would be prohibitive in cost for one-time use on film and a live production of some special commercials can be risky.

Non-Network Uses

The surface has scarcely been scratched in the use of tape on local stations. There are now some 90 stations equipped with video-tape recorders. When this number increases significantly there is no reason why video tape cannot be shipped to local stations for spot use just as film is today. But even more interesting to us than sending canned spots to local stations is the possibility of stations making spots and sending them to us for approval. We shall then be able to buy locally with some guarantee that what we buy is put on the air. A local station equipped with a TV tape recorder can send back to New York either a prerecording or a postrecording of the commercials as they actually will be or were

broadcast. In some cases the advertisers may insist that the station prerecord the live commercials, send them to New York for checking and then have them returned to the station for broadcast. Such a facility never existed before, but it is now already being used by several clients.

Changes for the Producer

We have learned a few things about production techniques in the last few months. For example, a few months ago I was firmly convinced that the only way to use tape was in continuous action or live technique. But in light of recent experience, I now feel that live technique should be used as much as possible, since it is here that tape's economic advantage can be best realized. But sometimes it is more economical to plan the shooting to take advantage of the ability to edit tape. In a difficult 2-minute commercial, for example, the chance of a technical or artistic error is twice as great as it is in a one-minute commercial. Rather than make 10 or 12 takes of the complete two-minute commercial trying for perfection, wouldn't it be better to break the 2-minute commercial down to three 40-second sections or two 1-minute sections, whichever seems appropriate, and then splice the sections together? Our experience answers yes. But most important in this kind of planning is to make the sequence in continuous order as the actors play so that the talent retains as much of the spontaneity of live as possible, and most importantly so that the director and producer can judge the pacing, timing and acting as they can in a live show or commercial. I do not recommend shooting tape as film is usually shot, out-of-sequence. On the few occasions where I have seen it done I have been disappointed in the results. I think it's because tape directors do not yet have enough experience to maintain performances out-of-sequence as do film directors. As they get more experience perhaps this will no longer be true.

Shooting out-of-sequence also eliminates one of the big advantages a director has in live television, that is, the ability to judge the whole program or commercial as he sees it unfold before him. But there are even better economic reasons to use multiple camera, live techniques as much as possible. In our experience, out-of-sequence has been more expensive. Shooting scene by scene in tape is almost as expensive as it is in film and for the same reasons. It takes longer to set up and shoot each scene individually because someone always wants to fix just one more light or move a chair an inch or put on another dab of make-up.

The business of retaining spontaneity of live television may get to be a big problem unless we are careful. The advantage of being able to do it over again in tape may prove to be a disadvantage unless good judgment is used as to what constitutes an unsatisfactory "take." I have seen takes rejected for minor technical reasons while they were artistically perfect—and substituted for them takes that were technically perfect, but artistically inadequate. We must keep stressing to those in authority that the commercial or show must be viewed in terms of its total effect on the home viewers, not for its effect on the technical or production people that are watching.

Video tape has created some interesting manpower problems. If a live show was on

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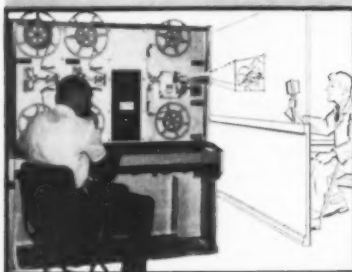
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Thursday night you knew it would be produced Thursday and perhaps you'd spend Wednesday and Thursday at the studio at a carefully pre-arranged time. But now that it is possible to tape shows and commercials in advance, you may find yourself taping a Thursday night broadcast on Saturday or Sunday at 10 A.M., or some other ridiculous hour. This situation makes it difficult to schedule a producer for a week's activity because he could be taping a show or commercial on any day of the week. As a matter of fact, the so-called convenience of tape has proven to be convenient to everyone but producers. We have worked more nights and weekends than we ever did in good old fashioned live television, but it's a small price to pay in return for the excitement of opening new frontiers in broadcasting.

Mixed Blessings of Video-Tape Recorders

By S. V. STADIG

The Videotape Recorder acquired by Station KYW-TV has brought with it new problems and opportunities. It has provided advantages but has some disadvantages.*

A Videotape Recorder was acquired by station KYW-TV in March 1958; it has been used intermittently from sign-on to sign-off—every day. Tube failures and adjustment problems have been minimized by turning the machine on at sign-on and not removing power until sign-off. This accumulates an average of 600 hours of filament and plate power per month.

The station has been averaging 60 to 80 hours per month of time when the heads were operating. Over 200 hours have been accumulated on a few heads. One head had a mechanical failure and another developed severe noise after only 40 hours of use.

One of the major problems encountered with tape from other stations is an RF beat pattern, erratic control track or audio hum, most of which can be attributed to improper degaussing. Having only one machine, it has been necessary to splice commercials and, on occasion, programs, back to back. This has been done with excellent results.

As we got into a heavier schedule of recording, it became apparent that, in order to keep some semblance of order in cataloging TV tapes and to be able to play tapes within minutes of each other without necessarily tying them together, the flexibility of small reels would solve many of our problems.

In addition, on frequent occasions, several takes would be made of a commercial and the client would choose any one of these several takes to be used on the air. This meant that an erashead on the machine would not have helped in these instances. Therefore, it is necessary to extract the desired takes from a large reel and put them on small reels.

This means we now have a number of

reels with a number of splices in them. After they have been run through the machine many times, dropouts become excessive immediately after these splices. It is possible to salvage these tapes by cutting out 6 or 8 inches of tape on either side of the original splice and making a new splice. The tape is now free of dropouts and we are able to obtain an additional number of replays before noise develops again. In one year we purchased 36 2400-ft (half-hour) reels.

Due to the number of retakes or playbacks necessary during each recording session, we have found it necessary to man the recorder during 90% of our recording sessions. It has been possible to accomplish 99% of our playback with the projectionist loading the tape machine and the Technical Director starting the tape machine by remote control.

As with any piece of electronic equipment, time has been spent incorporating modifications in our recorder. Modifications, necessary maintenance time and training of additional personnel have averaged 15 hours a week.

Maintenance: A thorough preventative maintenance program is required. A schedule of daily, weekly and monthly checks has been faithfully adhered to and we have had no major breakdown.

Identification Records: After several attempts, a bookkeeping system was evolved that seems to satisfy station needs for itemizing expenses, identification of tapes for stations and agency use, and tape history.

The history of each reel is kept by assigning it a number and on its record sheet noting each item or recording session, tabulated sequentially. There is a provision for Subject Matter, VTR Number, the Program Time and Remarks. This Reel History Log is stored with each reel.

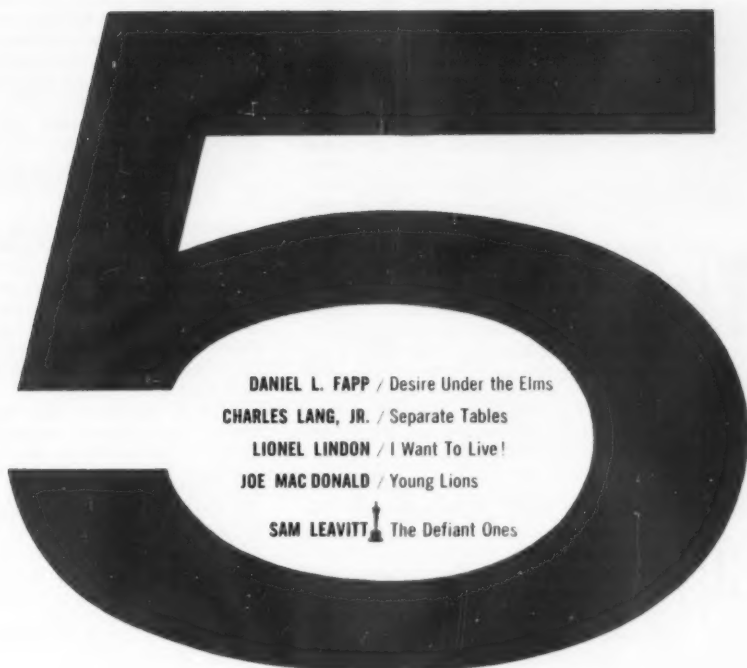
The recording order number is entered on a Master Log and each take is assigned a Video-Tape Recorder Number. If retakes are involved the retake is identified by a take suffix number added to the basic number. Only usable takes are recorded on the Master Log. The reel number and date of each usable take is also entered. The Master Log also notes Subject Title and Talent, Sort Time, Total Engineering Time, Editing Time and Head Number. A space is provided on this form for Remarks. The Master Log serves as a cross index between the recording number and various take numbers. If a video-tape recording is transferred from one reel to another, it is noted both on the Master Log and on the Reel History Log of each tape. A tape number with a prefix "X" indicates a 64-in. reel. Twelve-inch reels are assigned tape numbers without prefix.


We have not attempted to keep track of the number of plays on each tape but have ascertained that it is possible to get at least 100 plays on a tape without excessive dropouts, particularly if there are no splices involved. On some shorter reels with a number of splices, 75 plays has been the maximum.

The Video-Tape Recording Order is prepared by the Program Department which assigns an Order Number, Date, Program Title, Agency, Length, Date of Record, Dry Run Time, Camera Rehearsal Time and Record Time. Also on the form

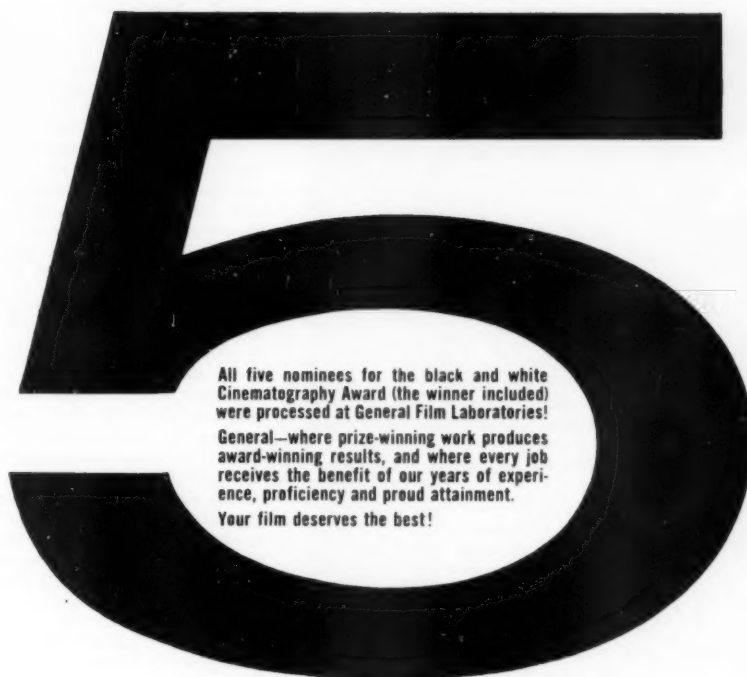
Condensed from a paper presented on May 8, 1959, at the Society's Convention at Miami Beach by S. V. Stadig, Westinghouse Broadcasting Co., Cleveland, Ohio.

*Trademark of Ampex Corp.



DANIEL L. FAPP / Desire Under the Elms
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The Accounting Department figures the charges under each of these categories, and prepares billing after work copies of the completed forms have been received from the various groups involved in the session. These groups log their respective man-hours under Breakdown of Time and Facilities at the conclusion of each taping.

Rehearsal Time: Producing local live television presents a number of contrasts to the production of a program or commercial on film. Usually, insofar as local independent telecasting is concerned, the practice is to set up the scenery, light the respective areas, check out shots, and conduct one, two or possibly three rehearsals. The last of these constitutes a dress rehearsal prior to the live presentation. This technique may vary depending on the simplicity or complexity of a program or commercial.

It is only fair to point out at this time that in producing a commercial or a program on tape it is as difficult for the telecaster as it is for a film producer to adapt his ways from film to television. If it were simply a matter of playing to a recorder as if it were an "on the air" show, that would be a real boon to the industry; however, it does not work that way. When the first attempt at this approach is played back, everyone, including the dolly pusher, is unhappy with what he sees. It is the same show or commercial that would have gone on the air had it been live, but now everyone has become even more acutely aware of undesirable shadows, improper inflection of the talent's voice, a video switch in the middle of a word, erratic camera dollying, etc. As a consequence, the spot has to be done over, not only once or twice, but often several times. Adding setup, rehearsal and tape time, it is not uncommon for a one-minute video-tape spot, which is now comparable to a Studio One production, to consume 3 to 4 hours.

Production Techniques: On a fast-moving commercial with many visual aids, tape time is cut down considerably if the audio is prerecorded by the talent and they lip-sync to it. This not only aids in making a more effective commercial, it also confines a complex one-minute spot to 60 seconds, whereas previously it would run anywhere from 60 to 80 seconds.

On simple commercial sets, picture composition, lighting, audio, switching transitions, visual background, timing, all become key factors. Psychologically, any minor irregularities seem to be magnified each time the tape is played back.

Typical Tape Activity: In the month of February, a total of 82 hours of head time was accumulated for recording and playback activity. This encompassed 54 recording orders with an assignment of 82 tape-recording numbers. The recording activity during this period was: commercial spot recording sessions — 1 hr 24 min; programs taped in advance — 4 hr 19 min; and incidental tape activities — 1 hr 23 min.

Thirty-seven hours of studio crew time was required to produce 7 hours of usable tape material. Fifty-three percent of the engineering time was spent on the commercial activity of 1 hr 24 min, and 47% on 5 hr 42 min of other tape activity. However, on the Program Department side, the Directors and stagehands devoted more than twice as much time to the commercials as they did to other tape activity. Unfortunately, these comparisons are difficult to evaluate on a program vs. engineering departmental basis that would have any industry-wide merit because of the different classifications of personnel in each TV station. Eighty percent of the total hours required for these sessions were available from the "slack time" of operating personnel. Total man hours were used in the following tabulation.

An expenditure of \$5,196 was incurred for all of the video-tape activity listed above. The charges accumulated were as follows:

Engineering labor.....	\$1,523
Maintenance (labor only)....	385
Depreciation (declining bal.)	1,671
Head wear	
(\$3.00/hr — 82 hr).....	246
Tape wear	413
Directors	490
Associate Directors	125
Stagehands	343
	\$ 5,196

We started out with a commercial video-tape rate that, to say the least, was very nominal. It was our feeling that it was only fair to ourselves and our clients to base charges on actual circumstances that develop as opposed to establishing an arbitrary rate that would put it out of reach of our local clients.

Out-of-pocket expenses attributed to taping for station use are not recoverable. It is the considered opinion of management that this expense is offset by the flexibility that is added to the program schedule and being able to obtain a greater number of local program hours without the necessity of adding additional crews or studio space.

The disadvantages of video-tape recording in our experience are the length of rehearsal and tape time, and the filing system of identification. Advantages include greater program flexibility and increased productivity of operating crews.

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Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products or services.

A method of producing television programs on tape that permits electronic editing (or mixing) of taped scenes and sounds has been announced jointly by Reeves Sound Studios, 304 E. 44 St., New York, and Radio Corp. of America. The new method involves the use of pre-recorded tapes bearing picture information from any number of cameras, along with the soundtracks.

Major elements of the system are eight RCA television tape recorders, two of which are equipped for color; one color and two monochrome live cameras; one monochrome and one color film chain with 16mm and 35mm projectors and slide projector; three electronic editing (mixing) rooms; and a master control room. The tape machines can be used as playback machines to provide picture sources, as well as recording machines to record the finished product. The live and film cameras are for additional picture and sound sources that may be integrated with taped material.

Each mixing room contains a newly designed transistorized switching system reported to switch from picture to picture in one-millionth of a second. Dissolve and effects amplifiers are associated with the switchers for picture mixing. The tape machines, live and film camera chains, and picture sources from outside of the building will be connected as the input picture to each of the switchers in the editing room, while director and editors view the picture inputs and final picture on monitors in the mixing rooms. The outputs of the mixing rooms are then connected to the tape machines to record the edited pictures. The master control will be a switching and monitoring point to interconnect major elements of the system such as mixing rooms to tape recorder inputs, outside lines to mixing rooms, etc. The master control will also monitor technical quality and control video operation of live and film camera chains.

The equipment, supplied by RCA, will be assembled in a rental studio, scheduled to be opened in the Fall, which will supply service facilities comparable to the Reeves Sound Studios' facilities for motion-picture and record firms.

A merger of Orr Industries, Inc., formerly Orradio Industries, Inc., manufac-




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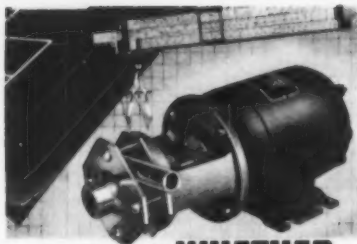
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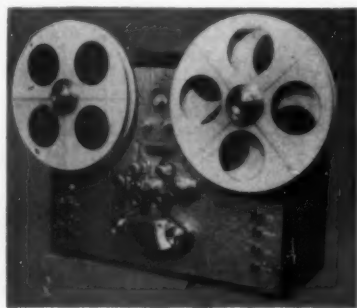
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turers of magnetic tape for audio, computer and video uses, and Ampex Corp. was approved at the annual meeting of Ampex stockholders. Terms of the merger provide that shareholders of Orr Industries will receive one share of Ampex common stock for each 2.2 shares of Orr Industries stock. During the last two years, Ampex has acquired about 25% of Orr Industries shares and during the last year has supplied management assistance to the Orr plant in Opelika, Ala.

Price of the Red Lake 35mm Stop Motion Projector (*Jour.*, p. 444, June 1959) is \$1495.00. The price was erroneously published as \$149.00. The *Journal* regrets the error.



The Norelco Continental "400" (Model EL 3536), 4-track stereo record and playback tape recorder has been announced by the High Fidelity Products Div. of the North American Philips Co., Hicksville, L.I., N.Y. Engineered and manufactured by Philips of the Netherlands, the recorder features 4-track stereo and monaural record and playback for tape economy. The recorder will also play back 2-track stereo tapes. The recorder has three speeds, $7\frac{1}{2}$, $3\frac{1}{2}$ and $1\frac{1}{2}$ in./sec and piano-key controls. It is compatible with conventional pre-recorded tapes.

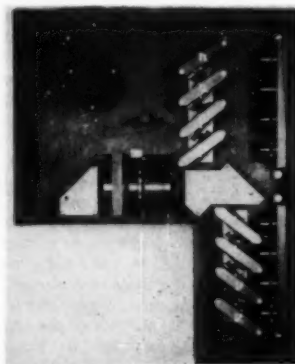


A portable magnetic film recording system for studio and location work has been announced by Wide Range Recording Corp., 527 No. Grand Blvd., St. Louis 3, Mo. The unit, Model 1017-BC is designed to record and reproduce on either 16mm or 17.5mm film. A two-channel head is incorporated to make possible the recording and reproducing of center and edge tracks on 16mm film without changing parts. The desired track is selected by turning a switch. The speed control relay for the drive motor is designed for versatility so that when the proper switch is set for the desired film speed, the film will run at either 36 ft/min

or 12 ft/min for 16mm film, and 45 ft/min or 90 ft/min for 17.5mm film. The unit incorporates a bias oscillator of the L-C tuner-grid type, operating at 60 kc and employing one 12AU7 tube operating in push-pull. The total distortion appearing at the oscillator output terminals is said to be less than 0.10%. All functions of the recorder are relay-actuated through interlock pushbutton circuits. Prices on the firm's 16mm-17.5mm equipment range from \$2800.

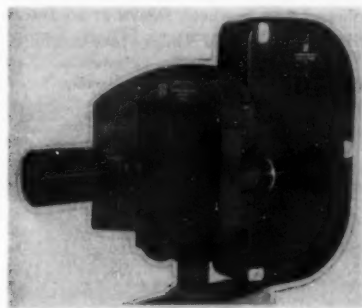


A new type of "split-out" for feeding a single source to two or more fully isolated loads has been announced by Studio Supply Co., a division of Studio Electronics Corp., 711 S. Victory Blvd., Burbank, Calif. The device is designed to combine networks for such uses as complete recordings of two or more independent sources, such as making monophonic recordings simultaneously with 2- and 3-channel systems without disturbing the independent stereo channels.

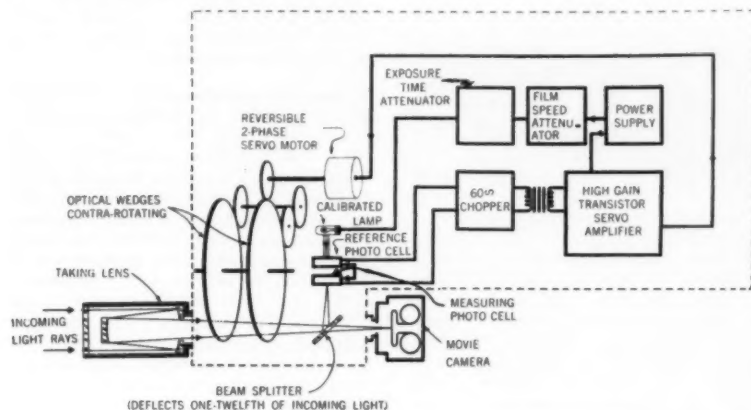


The FS Multiple Reduction Optical System for black-and-white reduction printing has been announced by Fish-Schurman Corp., 70 Portman Rd., New Rochelle, N.Y. The system is designed to produce eight 16mm images from a single 35mm negative. Essentially it consists of a long focal length lens which produces a virtual image of the 35mm negative at an infinite distance. This parallel beam system is split into two sections of equal illumination by means of a beam-splitting cube. Each one of these sections is then split into four equally illuminated parts by three beam splitters and a first-surface mirror for each section. The eight equally illuminated parts are then passed through eight short focal length lenses, and each lens provides a

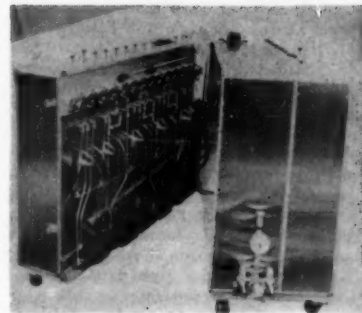
reduced image of the 35mm negative. All of these images are formed in line on a single plane, which simplifies the design of the eight 16mm micromechanisms. The 35mm negative is illuminated by a special lamphouse consisting of a four-element condenser system, a two-element relay lens and a single-element field lens. An infrared transmitting, visible light reflector is provided to remove infrared radiation from the light beam. The lamphouse also contains five neutral filters, each operated by a solenoid for 32-step light control.



The portable electric 35mm Newman Sinclair Kine Camera has been announced by James A. Sinclair & Co. Ltd., 3, Whitehall, London S.W.1. It is distributed in the United States by Paul Ivano, 8469 Hillside Ave., Hollywood. Overall dimensions of the camera, designed to be as small and light as possible, are height, 7 in.; width, 7 in.; length, 9 in. It weighs 6½ lb, including the tachometer and footage indicator. The camera can be supplied with standard friction or double register pin clamping type of film gate which enables the film to be run in reverse if desired by simply changing polarity of the battery leads. Film magazines, available for 200 ft or 400 ft of film, are attached to the camera by a simple push-on movement.



The Zoomar-Trulex, a device for automatic exposure control through the camera lens, is a product of Zoomar, Inc., Glen Cove, L.I., N.Y. The transmission compensation is achieved by two counter-rotating optical wedge discs. A beam splitter, absorbing 8% of the main light flux, works in conjunction with a computer and a built-in transistor amplifier for exposure control. The instrument, which weighs 7 lb,



A compact, portable versatile processor for Kodachrome, Anscochrome, Kodacolor, Ektachrome and black-and-white has been developed by the Time Automated Mfg. Co., 69-03 Woodside Ave., Woodside 77, N.Y. Called the Process Master, the processor is about 7 ft long, 3 ft wide and 4 ft high and weighs approximately 950 lb. For easy portability the machine is mounted on neoprene tread casters and by the removal of a single hinge pin can be separated in two parts for convenient handling. When separated into two parts the left half with the drybox remains operational and can be used for the less complicated process. This design also permits ease of maintenance with ready access to all pumps, electric fixtures and plumbing. The tanks are all of 316 type stainless steel. While the fittings are plastic. Teflon bushings are used on all rollers and on all moving parts submerged in the photo-chemicals. Air-knife squeegees are installed before each of the printing heads and the drybox. Temperature controls are maintained to $\pm 1^\circ$ by thermostatic controls. Speed of processing is from 0 to 100 ft/min depending on the film processed. 16mm Kodachrome is processed at 15 to 17 ft/min. Other 16, 35 and 16/35mm machines are planned.



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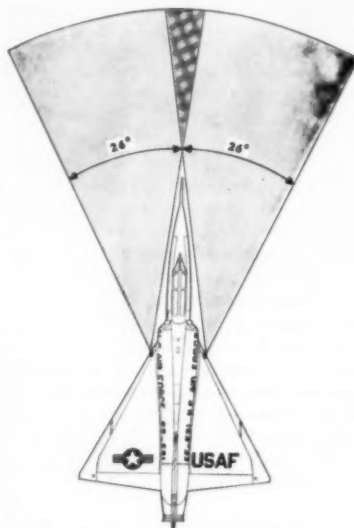
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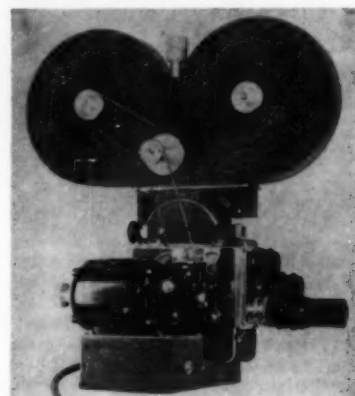
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A three-element lens made with three glasses chosen from a graph based on an optical formula devised by Max Herzberger of Kodak Research Laboratories is reported to be corrected for light from the ultraviolet to the infrared, or from 365 to 1010 mμ. The lens, called "superchromat" has been incorporated in telescope objectives; and work leading to its use for corrected camera lens and infrared optical systems is being carried on. The new optical formula differs from usual dispersion formulae in that it is linear. The dispersion formula depends upon four data for a given kind of glass. Given these constants, refractive indices for any wavelength of light can be computed. Two of these data, plotted against each other, give the curve from which the glasses for a "superchromat" are chosen. If optical characteristics of any three glasses fall in a straight line on this graph they will form a "superchromat" when correctly combined in a lens.



A special wide-frame strike camera for fire-control evaluation on the Convair F-106 delta-wing jet interceptor is produced by Benson-Lehner Corp., 11930 W. Olympic Blvd., Los Angeles 64. Announced as the first of a series, the camera is a 35mm, 400-ft capacity unit with a 1- by 3-in. format and a 6-in. lens. It is equipped with the necessary correlation systems, timing lamps and fiducial marks to give accurate metric information. Left- and righthand versions are designed to fit into the cambered leading edges of the Convair plane so that their angles of view overlap slightly. The two cameras make a simultaneous record during the fire-control period and give a combined panoramic view of about 52°. It is possible to have both a missile and target in camera view from launch to strike even though ranges may be from 10,000 to 20,000 ft.

A Kodak film called Linagraph Shellburst is used at the University of California to record tracks of high-energy atomic particles, such as pi mesons, in a "bubble chamber" which contains 150 gal of liquid hydrogen. The particles, emerging from the University's 6-billion-volt Bevatron, are piped to the bubble chamber. As they pass through the hydrogen they leave streaks of bubbles similar to jet vapor trails. The streaks are then photographed through the chamber's 5-in.-thick optical glass cover. Photographs made recently indicate the presence of strange particles of anti-matter called antilambdas. One of these photographs has been shown at an International Conference on High Energy Physics in Kiev, Russia.



The TCE (Toledo Cine Engineering) line of Bolex 400-ft magazines and accessories is now manufactured and distributed by S.O.S. Cinema Supply Corp., 602 W. 52 St., New York 19. The 400-ft magazine unit uses a saddle block permanently mounted to the Bolex camera with a light-tight cap when the magazine is not in use; 115 v synchronous motor for 24 frames/sec sound speed; recessed rollers for film protection; footage counter; gearbox with safety disconnect; motor/camera mount and On-Off reverse switch.

A new Elwood Foto-Meter, Model 92, similar to, but in a lower price range than the earlier Model Z-4 (*Journal*, p. 364, May 1958) has been announced by Foto-matic Corp., 2603 Kessler Blvd., N. Drive, Indianapolis 22, Ind. The new exposure meter is calibrated for ASA Film Indexes from 1.0 to 16,000; for lens stops from f/1 to f/45; lens speeds from 30 sec to 1/2000 sec; for motion-picture cameras at 8, 16, 24, 32, 48, and 64 frames/sec; for LVS (or EV) system, and for Polaroid. The scale in the meter view is marked off in increments of 1 through 13, each number being equivalent to one lens stop change on the camera. It is priced at \$47.50.

The Stereo Edition of *Understanding High Fidelity*, a handbook published by Bogen-Presto, a division of The Siegler Corp., Box 500, Paramus, N.J., describes in detail the components required for a complete high-fidelity system. The booklet distinguishes between stereophonic and monophonic systems in relation to the results which may be expected from each. The 64-page booklet includes a 4-page

glossary of technical terms and is illustrated by photographs and diagrams. It is available from dealers or directly from the firm at 25 cents a copy.

Marconi's Wireless Telegraph Co., Ltd., and **English Electric Valve Co., Ltd.** have announced appointment of **Ampex Corp.** of Redwood City, Calif., as authorized distributor in the United States of their sound and vision equipment and TV camera tubes. The agreement includes sale of the new Marconi MK.IV TV camera, which uses either 3-in. or 4½-in. image orthicons.

A new mount for the **Angenieux 18.5mm f/2.2** wide-angle lens has been designed by **Gordon Enterprises**, 5362 Cahuenga

Blvd., North Hollywood, specifically for use on **Arriflex 35mm** cameras. The 7-element lens provides extreme depth of field with a minimum of distortion. Optical surfaces are coated, and the diaphragm supplied with click stops. A resolution test film is supplied with all lenses.

A device to produce short-focus projector lenses for 35/70mm motion-picture installations is a product of **Vicom Inc.**, 70 Aberthaw Rd., Rochester 10, N.Y. Called the **Short Focus Adapter**, it was designed primarily to function jointly with lenses in focal lengths from 3.5 in. to 6 in., reducing these focal lengths by one-half. It has been corrected for aberrations, including distortion and color. It will be priced at approximately \$600 per lens.

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Photographic Specialist. Require professional for executing photographic assignments in creative application of all available photographic techniques and equipment. Applicant must interpret requirements of those using photo lab facilities. Direct and photograph motion pictures and stills. Direct the work of other photographers and technicians. Send resume to: **W. O. Borden, Employment Office, Convair-Astronautics, Cocoa, Fla.**

Engineers, Mechanical & Electronic. Experienced in design, production, manufacture of photographic consumer and/or military products and instrumentation. Must be familiar with motion-picture camera and projector design; capable of creative simple design solutions for economical production manufacture; knowledge of dimensioning for parts interchangeability. Opportunity to join reputable engineering staff of progressive, rapidly growing organization. **Foto Development Corp.**, 123 Eileen Way, Syosset, L.I., N.Y.

Designer. Expanding manufacturer needs designer with experience in motion-picture laboratory equipment. Write or call **Forway Corp.**, 245 West 55 St., New York 19. CO 5-0372.

Cinematographer-Editor. Small organization in Chicago area requires capable industrial cameraman for work in 16mm color, combining editing and some still work for sound slidefilms. Man selected must have good college background, married, under 35. Recent grads with good college background in motion picture-TV or cinematography will also be considered. Good income with excellent opportunities for advancement. Please furnish references, salary requirement and qualifications. Address P.O. Box 244, Park Ridge, Ill.



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Positions Wanted

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Motion Picture Cameraman. Active member SMPTE now employed at local film studio. Formerly with Telenews and CBS-Newfilm. Just completed study in film production in the States with M.S. degree. Owner of 16mm Bell & Howell and 35mm Arriflex cameras. Desire film assignments in Formosa and neighboring countries—16/35, color/B&W, news, documentary, educational and production work. Write: **Dennis K. Chin**, P. O. Box 222, Taipei, Taiwan.

Chemist. Over 6 yrs experience with major laboratory in color and black-and-white developing, quality control, troubleshooting and processing equipment. Write: **Marvin Leff**, 2109 76th St., Brooklyn 14, N. Y.

Cameraman—Motion, Still, Aerial. 7 yrs experience, Navy and civilian school graduate. Experienced in aerial, still, data gathering and motion-picture production photography and equipment. Employed by major aircraft corporation and Cape Canaveral Missile Test Range. Past membership in American Society of Photogrammetry, Active Member of SMPTE. Single, age 27, will relocate. Prefer position as photog. coordinator or motion-picture cameraman with large corporation. 1808 Tower Rd., Glen Burnie, Md.

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Position requires familiarity with all phases of movie making, including filming, lighting, power and equipment requirements, film editing, animation techniques, sound recording and editing, color processes and their combination.

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Here Jack Philo, Avco cameraman, uses an Arriflex 16 during "data cassette program" on Cat Island, one mile off Marblehead, Mass. That's a 32 inch telephoto lens mounted on the Arri. Avco cameramen carry the rugged ARRIFLEX wherever they travel in conjunction with this new data recovery program.



Arriflex 35 and foul-weather gear sported by Jack Philo during one phase of "data cassette program", in which a capsule in a test drop is recovered off Marblehead on the windswept New England coast. During critical experiments Arriflex motion picture cameras are in use 24 hours a day.



Avco cameraman Mel Miragliotta checks out telescope and 600mm lens alignment on his dependable Arriflex before leaving for the drop test site off Marblehead. The experiments were recorded from Cat Island, a lobster boat, and a high-flying plane. The one thing all have in common...an Arriflex aboard.



The Arriflex is used in-plant too. Here it is shown photographing new instrumentation in an environment test program. Through these films, the Air Force can evaluate Avco's progress on contracts to produce re-entry vehicles for Titan & Minuteman ICBM's.



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News Columns

86th SMPTE Convention	615
Advance Program	616
Exhibit Directory	628
Fifth International Congress on High-Speed Photography	638
Education, Industry News	638
Obituaries: George L. Carrington, Sr.; William G. Stuber	646
Biographical Notes: Robert S. Burnap; A. H. S. Craeybeckx	648

Video Tape Reports From Miami Beach Convention, New Horizons for Television Tape, by Ross H. Snyder; The Ampex Videotape Recorder and Its Performance on Foreign TV Standards, by Kurt R. Machein; An Advertising Agency's Experience With Video Tape, by Alexander Cantwell; Mixed Blessings of Video-Tape Recorders, by S. V. Stadig	650
New Products	661
Employment Service	665

Advertisers

Animation Equipment Corp.	624
Arriflex Corp. of America	666
Audio Engineering Society	632
Bell & Howell Co.	629
Berndt-Bach, Inc.	639
Camera Equipment Co.	633, 634
Camera Mart, Inc.	627
Canadian Applied Research Ltd.	647
Century Lighting, Inc.	621
Cine Speed, Inc.	660
Cinema Engineering Co.	657
Diamond Power Specialty Corp.	652
Eastern Effects, Inc.	636
Electronic Applications, Inc.	622
Electronic Systems, Inc.	641
Employment Adv.	665
Filmline Corp.	620
Fish-Schurman Corp.	642
Oscar Fisher Co.	662
Florman & Babb, Inc.	631
General Film Laboratories, Inc.	659
Gevaert Photo-Producten N.V.	619
Hollywood Film Co.	645

Houston Fearless Corp.	653
Philip A. Hunt Co.	649
La Vezzi Machine Works	661
Macbeth Instrument Corp.	646
Macbeth Sales Corp.	626
Magnasync Mfg. Co., Ltd.	623
Mecca Film Laboratories, Inc.	650
Motion Picture Printing Equipment Co.	625
Movielab Color Corp.	655
Moviola Mfg. Co.	654
Peerless Film Processing Corp.	638
Permafilm, Inc.	630
Photo Research Corp.	661
Precision Laboratories	648
Prestoseal Mfg. Corp.	663
Professional Services	656
RCA Film Recording	635
Rapid Film Technique, Inc.	664
L. B. Russell Chemicals, Inc.	643
S.O.S. Cinema Supply Corp.	637
Time Automated Mfg. Co.	640
Tri Art Color Corp.	651
Unicorn Engineering Corp.	644
Vicom, Inc.	658

Meeting Calendar

American Chemical Society, National Meeting, Sept. 13-18, Atlantic City, N.J.
Standards Engineers Society, Annual Meeting, Sept. 21-23, Somerset Hotel, Boston, Mass.
Instrument Society of America, Annual Instrument-Automation Conference and Exhibit, Sept. 21-25, International Amphitheatre, Chicago, Ill.
IRE, Conference on Non-Linear Magnetics and Magnetic Amplifiers, Sept. 23-25, Shoreham Hotel, Washington, D.C.
AICE, Sept. 27-30, St. Paul Hotel, St. Paul, Minn.
National Symposium on Telemetering, Sept. 28-30, Civic Auditorium and Whitcomb Hotel, San Francisco.
IRE and AIEE, Industrial Electronics Conference, Sept. 30-Oct. 2, Muebach Hotel, Kansas City, Mo.
11th International Cinematography Engineering Congress, Oct. 1-3, Turin.
IRE, Aeronautical Communications Symposium, Oct. 5-7, Hotel Ulca, Ulca, N.Y.
86th Semiannual Convention of the SMPTE including Equipment Exhibit, Oct. 5-7, Statler Hilton Hotel, New York.
IRE Canadian Convention, Oct. 7-9, Toronto, Ont.
Optical Society of America, Annual Meeting, Oct. 8-10, Chateau Laurier Hotel, Ottawa, Ont.
ASCE, Los Angeles Convention, Oct. 9-13, Hotel Statler, Los Angeles.
AIEE, Fall General Meeting, Oct. 11-16, Chicago.
National Electronics Conference, Oct. 12-14, Hotel Sherman, Chicago.
National Society of Professional Engineers, Fall Meeting, Oct. 15-17, Olympic Hotel, Seattle, Wash.

ASCE, Annual Convention Oct. 19-23, Hotel Statler, Washington, D.C.
American Standards Association, National Conference on Standards, Oct. 20-22, Sheraton-Cadillac Hotel, Detroit, Mich.
Acoustical Society of America, Fall Meeting, Oct. 22-24, Wade Park Manor Hotel, Cleveland, Ohio.
Society of Photographic Scientists and Engineers, Oct. 26-30, Edgewater Beach Hotel, Chicago.
IRE, Electron Devices Meeting, Oct. 29-31, Shoreham Hotel, Washington, D.C.
Louisiana Polytechnic Institute, Instrumentation Conference, Nov. 5, 6, Ruston, La.
IRE, Instrumentation Conference, Nov. 9-11, Atlanta, Ga.
Sixth National Symposium on Reliability and Quality Control, Jan. 11-13, 1960, Statler Hilton Hotel, Washington, D.C.
IRE National Convention, Mar. 21-24, 1960, Coliseum and Waldorf-Astoria Hotel, New York.
Inter-Society Color Council, 29th Annual Meeting, Apr. 11, 12, 1960, Philadelphia Museum College of Art, Philadelphia.
87th Semiannual Convention of the SMPTE, May 1-7, 1960, Ambassador Hotel, Los Angeles.
Fifth International High-Speed Congress and Equipment Exhibit, including the 88th Technical Conference of the SMPTE, Oct. 17-21, 1960, Sheraton-Park Hotel, Washington, D.C.
89th Semiannual Convention of the SMPTE, May 1-5, 1961, Royal York, Toronto.
90th Semiannual Convention of the SMPTE, Oct. 16-20, 1961, New York.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections, Subsections and Chapters, and of the Committee Chairmen and Members were published in the April 1959 Journal.

sustaining members

of the Society
of Motion Picture
and Television Engineers

The objectives of the Society are:

- Advance in the theory and practice of engineering in motion pictures, television and the allied arts and sciences;
- Standardization of equipment and practices employed therein;
- Maintenance of high professional standing among its members;
- Guidance of students and the attainment of high standards of education;
- Dissemination of scientific knowledge by publication.

Progress toward the attainment of these objectives is greatly aided by the financial support provided by the member companies listed below.

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The Society invites applications for Sustaining Membership from other interested companies. Information may be obtained from the Chairman of the Sustaining Membership Committee, Byron Roudabush, c/o Byron Motion Pictures, Inc., 1226 Wisconsin Ave., N.W., Washington 7, D.C.

